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ABSTRACT

This vocational safety guide is designed to help Missouri school practitioners at all levels in providing for the safe instruction and work associated with practical arts and vocational and technical subjects. Covered in the individual sections of the guide are the following topics: Missouri legislation and regulations pertaining to school safety; levels of responsibility (state, district, building, and community level responsibilities); liability (the potential liability of educational personnel, insurance, insurance-related statutory requirements, and the legal status of liability coverage in Missouri); safety program recommendations (instruction, evaluation, recordkeeping, inspections, and organization and approval); safety program recommendations concerning facilities and equipment (classrooms and laboratories, environmental factors, machinery guarding, and material handling); safety program recommendations pertaining to personal protective equipment (eye and face protection, head protection, food protection, hand and body protection, and radiation safety); safety regulations pertaining to vocational special needs students (individualized educational plan development, suggested teaching techniques and special needs resources); and useful information sources. (MN)

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Vocational Safety Guide

To Generalized Safety Provisions As They Apply To:

Agricultural Education
Business and Office Education
Health Occupations Education
Home Economics Education
Industrial Arts Education
Marketing and Distributive Education
Trade and Technical Education

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PREFACE

This Guide was developed pursuant to a grant from the Research Coordinating Unit of the Division of Career and Adult Education in the Department of Elementary and Secondary Education. As such, this guide is intended to provide a service to practitioners in Vocational, Technical and Practical Arts Education.

The research team that authored much of this document, together with the project's advisory committee, as well as the RCU staff, agreed on the development of a Guide that would bridge the gaps between the overall school system focus of Missouri's existing Administrative Guidelines for School Safety (1977) and the very specific and detailed subject area guides available to teachers (e.g., Oxy-acetylene Welding Safety Guide). To this end, the research team has assembled a guide to help school practitioners at all levels, in providing for the safe instruction and work associated with practical arts and vocational, technical subjects. This guide is applicable to all vocational education, technical education and practical arts programs at secondary, postsecondary and adult levels. This includes at least courses in:

- Agricultural Education
- Business and Office Education
- Trade and Industrial Education
- Industrial Arts Education
- Technical Education
- Home Economics Education
- Consumer and Homemaking Education
- Marketing and Distributive Education
- Health Occupations Education

Because professional and moral responsibility are the primary motivating forces that generated the decision to develop this safety guide, as contrasted to the guide being necessitated by the demands of law, this guide is intended to apply to all courses in programs such as those listed--regardless of whether or not these courses are federally reimbursed with Vocational Education Act funds.

It should be noted that significant care and attention was invested in the preparation of this Guide so that errors and omissions would be prevented. Invariably with a guide that attempts comprehensive coverage, some will surface and/or some recommendations will not fit a specific situation as well as another. In all cases, instructors and supervisors are encouraged to consider their own needs and act accordingly. In this way sound principles will be applied to specific situations by that essential process, namely the professional judgement of teachers, specialists and administrators intimately familiar with the needs of these situations.

A comprehensive document such as this guide necessarily involves the commitment and effort of a large group of people. Therefore, the research team appreciatively acknowledges the willingness of the project's advisory committee members to share their expertise, time, and practical insight. All were provided in significant amounts. This committee's input, together with that derived from a systematic needs assessment of Missouri's practical arts and vocational technical education practitioners, served to tailor the contents of the Guide directly to our state's needs.

Furthermore, the efforts of hundreds of colleagues across the nation must also be recognized. The research team often chose to adopt portions of safety guides developed by other states. These decisions were made to capitalize on the investments of time and efforts of our professional colleagues and to broaden the scope of this Guide. Of course the research team offers this document to others in the same spirit of cooperation.

Finally, these acknowledgements and introductory remarks would not be complete without specific mention of our debt to the outstanding efforts of the secretarial team that generated countless draft versions, background sections and, of course, the final copy. Without the cheerful labor of Patricia Love, Laura Waugh and Susan Hencken, this guide would certainly not have been completed.

To these individuals, to the Division of Career and Adult Education that felt the need for such a guide, as well as to the many others that are not specifically mentioned due to space restrictions, the project team expresses a most sincere "Thank You!"

Michael J. Dyrenfurth
Richard E. Linhardt

Using This Guide

Overview

The purpose in producing this Guide was to be of help to practical arts and vocational technical educators as they grappled with the serious challenge of providing for the safety of their students. The Guide is written to be as encompassing of all service areas as possible but there will invariably be specific situations that are unaccounted for. It is hoped however that the principles outlined are applicable.

Instructors are encouraged to:

- detail the Guide's suggestions and tailor them to the specific course, student and facility requirements that may exist.
- search for additional standards and practices that will make their courses even safer.
- consult with their service area supervisors and local safety specialists to assist in developing their own safety program.

What Will The Guide Show Me?

Because the Guide was based on a needs assessment, instructors will find that it addresses many of the most asked questions in the arena of safety. For example:

1. What Missouri Laws govern the vocational education safety arena?
   - Chapter I's Missouri Specifics section highlights these.
2. Who has what responsibilities in providing for the safety of vocational education's students?
   - Chapter II outlines a slate of responsibilities that good practice would seem to suggest. Readers will note that few can only be handled at one level or position, but all together they mesh to generate the comprehensive blanket of safety concern that educators would want to provide their students.
3. What is my liability potential? Can I be sued?
   - Chapter III attempts to outline this most difficult question. Although only the courts will decide cases that reach litigation, this chapter provides an interpretation of precedents and reasoned opinion. Note that the chapter does not substitute for specific legal counsel.
4. How can I protect my students and myself best?

- Chapter IV contains safety program recommendations directed mainly at teachers concerned with extablishing a comprehensive safety program that minimizes risk to students and liability potential to instructors and schools.

5. What safety guidelines apply to vocational laboratories and their equipment?

   - Chapter V outlines classroom, laboratory, environmental and machine safety measures that combine with the planning suggested in Chapter IV to provide for a maximum of student safety.

6. What protective devices should students use?

   - Chapter VI describes essential personal protective equipment and its suggested use and maintenance.

7. But how can I provide for the safety of special needs pupils?

   - Chapter VII begins to address this most challenging topic. It begins with the premise that a comprehensive safety program is already in place and that hence only the consequence of a pupil's special handicapping conditions will now need to be addressed.

8. OK, but I've looked it all over and I still need/want more information--where do I go for additional help?

   - Chapter VIII provides referenced sources, a list of additional sources deemed to be helpful and also a list of national and Missouri agencies that can provide appropriate assistance.

References and Citations

Note that numbers in parentheses () refer to source documents as numbered in the Referenced Materials listing provided in Chapter VIII. For reasons of detail, the legal citations in Chapter III are presented in conventional form at the bottom of each page. Also, throughout this Guide, the broken underline will be used to refer to another section/chapter found within this Guide.

Chapter 1 Introduction

OBJECTIVES

The objectives of this safety guide are to provide Missouri's vocational directors, supervisors, and instructors with:

1. a guide that supplements the Administrative Guidelines for School Safety by addressing safety as it specifically applies to practical arts and vocational technical education.

2. a description of the legal and professional responsibilities pertaining directly to vocational education, boards of education, administrators, teachers, students, parents, and cooperative education employers.

3. an overview of the liability potential of all vocational programs and personnel within the school and a list of recommendations to provide protection (i.e., minimize liability potential).

4. a set of safety program recommendations including such items as accident record forms, evaluation procedures, facility recommendations, equipment recommendations and suggestions for instruction.

5. a guide to assist instructors in developing World of Work relevant safety attitudes, skills and knowledge in students.

MISSOURI SPECIFICS

Each state presents a unique set of circumstances related to vocational education safety. This section highlights those aspects of Missouri's situation that are unique. As such, this section includes mention of: state codes that specifically pertain to vocational safety, the applicability of OSHA regulations to Missouri's schools, and this guide's relationship to the existing school safety guidelines.

Liability of the State

"It is a long-established principle of common law that the state is not liable in damages for injuries resulting from the negligence of its officers, agents, and employees" (7, p. 115).

Liability of School Districts

"Because school districts are agencies or arms of the state it has been held that the immunity which clothes the state also clothes school districts and their administrative bodies--boards of education" (7, p. 115).

OSHA and Missouri

Missouri does not have a federally approved state plan for safety and health. Therefore, Missouri public schools are not subject to any direct safety and health regulation under OSHA. However, teachers are liable under common law should an accident occur.

Missouri Eye Safety Law

Missouri has enacted a specific law governing eye protection (Missouri Revised Statutes, 1978. #170.005, 170.007, 170.009). Details related to these statutes are found in this Guide's Personal Protective Equipment Section.

Administrative Guidelines For School Safety

School personnel should note the document, Administrative Guidelines For School Safety, as prepared by the Department of Elementary and Secondary Education. This addresses general school aspects, school transportation safety planning, and it provides a sample of Board of Education recommendations for safety education and emergency preparedness.

Child Labor Requirements

Missouri law does not presently treat cooperative education specifically. However, child labor age prohibitions may be waived, for selected occupations only, where the student-learner is enrolled in a course of study and training in a cooperative vocational training program under a recognized state or local educational authority or in a course of study in a substantially similar program conducted by a private school; and such student-learner is employed under a written agreement which provides: (1) that the work of the student-learner in the occupations declared particularly hazardous shall be incidental to his/her training; (2) that such work shall be intermittent and for short periods of time and under the direct and close supervision of a qualified and experienced person; (3) that safety instructions shall be given by the school and correlated by the employer with on-the-job training; and (4) that a schedule of organized and progressive work processes to be performed on the job shall have been prepared. Each such written agreement shall contain the name of the student-learner, and shall be signed by the employer and the school coordinator or principal. Copies of each agreement shall be kept on file by both the school and the employer. This exemption for the employment of student-learners may be revoked in any individual situation where it is found that reasonable precautions have not been observed for the safety of minors employed thereunder. It should also be noted that many employers and insurance companies set safety standards above those specified in Child Labor Requirements in Nonagricultural Occupations (40).

Chapter 2 Levels of Responsibility

The basic purpose for a safety program in an educational system is to instill in vocational education's clients the importance of safety in the work place and classroom so as to prevent injuries to students, teachers, and graduates. Because the establishment and maintenance of a safe environment for students enrolled in vocational programs requires a team effort from all levels of the educational system, this section of the handbook seeks to identify the responsibilities of each person in the educational system. When all parties accept and execute their appropriate responsibilities, then a complete and effective safety program will result. Furthermore, such action will insure consistency throughout the system.

It is important to note that the outlined responsibilities are not exclusively derived from law. Because of Missouri's minimum legislative intervention approach, there are few laws that specifically apply to vocational education safety. However, there are a large number of desirable practices and national consensus standards that apply to practical arts and vocational technical education because they represent the "safe way of doing things."

Because responsibility is distributed throughout the educational system, no one is exempt. The following sections categorize responsibilities by levels--state, district, school/building, and community. Figure 1 provides an organization chart that depicts one possible configuration of responsibilities. Note that given the variability of local organizational patterns, some responsibilities may be assumed by different members of the educational system. However, to maintain the integrity of the overall safety program, it is imperative that all recommendations are accounted for and that each individual is aware of his/her specific responsibilities.

STATE LEVEL RESPONSIBILITIES

Department of Elementary and Secondary Education

1. Distribute superintendent's priority checklist for safety education prior to the start of the school year (21).

2. Provide leadership and subsequent assistance with the preparation and distribution of recommendations and materials for a school safety program applicable to practical arts and vocational technical education.

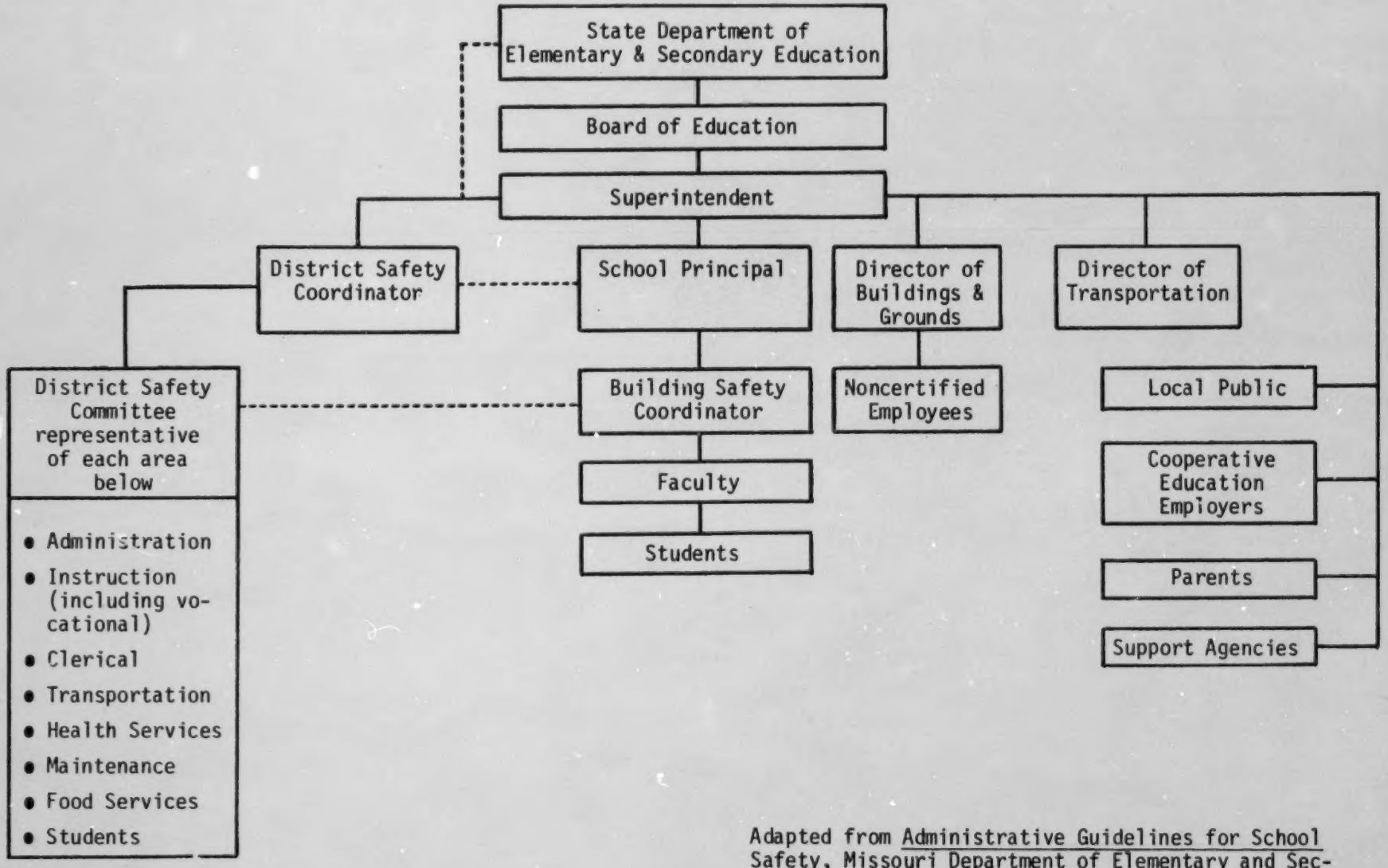
3. Administer, encourage, and provide leadership to school safety programs that implement state laws and recommended safety procedures relevant to practical arts and vocational technical education.

4. Provide specialized consultant services involving safety (21).

5. Assist in legislative proposals for adequate implementation and operation of school safety programs at the district and state level (21).

6. Administer and dispense state and federal funds when appropriate for school safety programs (21).

Figure 1. Possible Organization Patterns for Safety Education



Adapted from Administrative Guidelines for School Safety, Missouri Department of Elementary and Secondary Education, August 1977.

District Level Responsibilities

Local Board of Education Responsibilities

1. Develop a policy statement regarding school safety (21).
2. Select and appoint a safety advisory committee (21).
3. Be aware of and consider safety and emergency disaster planning when reviewing school construction specifications (21).
4. Establish policies related to school personnel assignments and responsibilities in the area of vocational, technical, and practical arts safety.
5. Comply with competent legal advice concerning the status of school personnel and school property in time of normal instructional segments of the safety program, emergencies, drills and exercises (21).
6. Provide efficient and safe practical arts and vocational technical education facilities and equipment (32).
7. Provide liability insurance and legal services to employees as commensurate with law and/or agreements (32).
8. Fund sufficient and necessary improvements, facility maintenance projects, safety supplies and equipment purchases to produce a safe instructional environment (48).
9. Require that the practical arts and vocational technical education curriculum devotes sufficient time for safety instruction.
10. Evaluate performance of district and school administration and teachers regarding safety procedures, equipment and safety instruction quality (48).
11. Provide for the safety of students when innovations involving curriculum changes are made (48).
12. Incorporate a safety review as an integral part of the evolution of new and/or remodeled facilities (48).
13. Inform practical arts and vocational technical education instructors of any specific insurance coverage arranged through district policies.
14. Appoint a safety coordinator for the school district and adopt a job description that includes practical arts and vocational technical education safety responsibilities (34).
15. Provide and/or support in-service training of practical arts and vocational technical education teachers in the area of safety (34).

16. Regularly inform administrators and instructional staff of their legal safety obligations and of any relevant changes therein (47).

17. Provide for inspection and enforcement of established safety regulations (47).

18. Approve and/or revise the practical arts and vocational technical education safety program as advanced by faculty and administration.

Superintendent/President Responsibilities

1. Provide for the overall administration, budgeting, development, organization, personnel assignment, evaluation, and updating of the school safety program (21).

2. Appoint Director of Safety or assign such overall responsibility to one person (21).

3. Provide appropriate administrative and financial support to the practical arts and vocational technical education safety program (21).

4. Implement an accident reporting system to establish data for improvement of administrative, instructional, and protective measures (21).

5. Work towards ongoing school and community interest in safety (21).

6. Request sufficient and necessary improvements, facility maintenance projects, safety supplies and equipment to produce a safe instructional environment for practical arts and vocational technical education.

7. Insure that the practical arts and vocational technical education curricula devote sufficient time for safety instruction (48).

District Safety Coordinator Responsibilities

1. Coordinate school safety functions (34).

2. Establish, guide, and provide assistance to school safety committees.

3. Provide for and participate in school safety inspections (34).

4. Establish a communication system to keep teachers and administrators abreast of new safety standards and procedures (34).

5. Provide for and assist in the implementation of a comprehensive safety program.

6. Research special safety problems that may exist (34).

7. Obtain and disseminate safety relevant material (laws, regulations, policies, guidelines, inspection checklist, posters (34).

8. Analyze, report, and record all accidents (34).

9. Prepare annual safety report for the administration and make appropriate recommendations (50).

10. Act in an advisory capacity, to the administration, on all matters pertaining to accident prevention (50).

11. Conduct personal investigation of fatal, serious and potentially serious accidents (50).

12. Supervise or cooperate with subject matter supervisors and instructors in the safety training of students (50).

13. Maintain professional contacts outside the school environment to exchange information with others and to keep the accident prevention and safety instruction program current (50).

14. Insure that federal, state, or local laws, ordinances, regulations, and codes bearing on safety are complied with (50).

15. Initiate and continue activities that stimulate and maintain teacher and student interest in accident prevention (50).

16. Implement, supervise, and evaluate appropriate safety education programs, including curriculum, instruction, or staff improvement courses or seminars (21).

17. Provide for the maintenance of relevant student records such as health and physical examinations (21).

18. Develop emergency plans and procedures for the entire school district (21).

Director of Buildings and Grounds Responsibilities

1. Locate and chart all valves, switches, and lines of all utility services. Distribute these charts to all administrative and safety personnel and where appropriate, to practical arts and vocational technical education faculty (21).

2. Paint in accordance with approved color coding all water, steam, gas, and other tubular conduits and indicate with numerous arrows the normal direction of flow of fluids, both within buildings and on school grounds (21).

3. Perform periodic inspections to insure utility controls are operational and post charts for use by other personnel during emergencies (21).

4. Provide for emergency operation or control of utility services during disasters (21).

5. Perform periodic inspections of government and/or community disaster supplies (21).

6. Inspect, report to an assigned coordinator, and repair damaged equipment or facility areas, including hallways, classrooms, playground, shops (21).

7. Inspect and maintain protective equipment and emergency facilities including items within practical arts and vocational technical education laboratories and shops (21).

8. Assist in developing disaster/emergency preparedness and safety programs (21).

Safety Committee Responsibilities

1. Arouse and maintain the interest of school administrators, supervisors, and teachers, and help them understand that safety is everybody's business (50).

2. Arouse and maintain the interest of students and convince them that they play an essential role in the prevention of accidents to themselves and others by planning and effecting safety demonstrations, contests, and displays (50).

3. Make safety activities an integral part of the whole institution's operating policies and methods (50).

4. Provide an opportunity for the open discussion of accidents, safety problems and preventative measures (50).

5. Discuss and formulate prevention policies and recommend their adoption to school administrators (50).

6. Identify unsafe conditions and practices and outline appropriate solutions (50).

7. Develop and revise safety recommendations specific to practical arts and vocational technical education (50).

8. Promote first aid training for practical arts and vocational technical education faculty (50).

9. Review faculty developed safety programs (50).

BUILDING LEVEL RESPONSIBILITIES

Principal's Responsibilities

1. Implement and supervise the overall safety program at the building level (21).

2. Plan and disseminate safety program information to staff, students, parents, and other district personnel (with assigned duties in that building) (21).

3. Provide for school nurse appointments (21).

4. Recommend and/or appoint a building safety coordinator as well as other building level safety personnel as appropriate.

5. Conduct or provide for safety inspections of school facilities including specialized practical arts and vocational technical education laboratories (20).

6. Provide for the enforcement of accepted practices (47).

7. Review curriculum for the inclusion of safety instruction (47).

8. Maintain contact with the local, state, and national agencies which provide safety information and services (19).

9. Secure support from, and maintain liaison with, system administration with respect to:

   a. the approval of the overall safety education program.
   b. securing adequate budgetary support for safety items and activities.
   c. expediting building changes necessary for safe operation.
   d. procuring safety equipment.
   e. reporting and investigating accidents.
   f. selecting instructors with specific knowledges and abilities to establish safe practices, procedures and environments.
   g. arranging for administrative measures that reduce liability of staff members (50).

10. Provide positive leadership for an active and continuous school safety program and foster incorporation of safety education and school safety program activities as part of the educational program, by:

    a. initiating a specific program of safety instruction (50).
    b. promoting school-wide attitudes toward accident prevention (50).
    c. establishing in-service training in accident prevention for teachers (50).
    d. encouraging staff to maintain first aid proficiency.
    e. requiring that safety supplies and emergency procedures are current and properly organized.
    f. encouraging the instructional staff to be knowledgeable and proficient in the use of fire and other emergency apparatus.

11. Implement the safety program by (50):

    a. checking periodically to insure the adopted safety program is in effect.
    b. observing teachers for implementation of safety instruction as an integral part of the course of study.
    c. stimulating the discovery, analysis, and prompt correction of unsafe conditions or practices.
    d. supporting teachers in enforcement of safety regulations.
    e. reviewing accident reports.
    f. establishing procedures for investigating and analyzing accidents.

12. Provide safe facilities and services by:

    a. reporting unsafe structural conditions to higher authorities (50).
    b. planning with teachers for the removal of unsafe structural conditions and other hazards, and for the installation of safety devices (50).
    c. inspecting facilities regularly for condition of equipment and safety devices, proper housekeeping, and adequacy of exits, ventilation and material handling systems.
    d. requiring that safety and applicable safety regulations are regularly reviewed.
    e. providing class sizes that are in keeping with student characteristics as well as the capacity, square footage, and number of work stations available in each facility.
    f. providing a procedure for the removal of students who repeatedly violate established safety rules and regulations and who are identified as safety hazards.

13. Secure cooperation of outside personnel and agencies by (50):

    a. assisting teachers in locating community personnel and services which will be helpful in the safety program.
    b. encouraging resource personnel to assist in the school's practical arts and vocational technical education safety program.
    c. regularly informing the public about the school's safety education program.

<u>School Building Safety Coordinator Responsibilities</u>

1. Coordinate the plans and educational activities for his/her school with those of other schools in the system (21).

2. Request, maintain, and check school safety supplies, materials, and equipment (21).

3. Obtain, prepare, and evaluate safety curricular materials (21).

4. Assist teachers in incorporating safety instructional materials in their courses of study (21).

5. Report periodically on the status of the school safety program (21).

6. Request/provide for the training of all building personnel in emergency procedures and in-service safety workshops.

7. Work with faculty to insure adequate safety inspection of school facilities.

8. Assist the Director of Safety in implementing the overall safety program.

Teacher Responsibilities

1. Comply with safety policies and regulations and systematically implement the approved safety program.

2. Always provide for the supervision of students in the classroom or laboratory in accordance with legal requirements. Do not leave the classroom and/or laboratory unsupervised at any time when students are present or when they might enter in your absence (34).

3. Motivate students to strive for safety (32).

4. Set a good example for the students by observing all safety rules and practices (19).

5. Perform in a manner which is commensurate with that of a reasonable, prudent person (38).

6. Establish course specific emergency procedures (10).

7. Enforce all safety rules and regulations (48).

8. Properly plan and/or arrange facility and equipment (10).

9. Devise and enforce safe housekeeping procedures.

10. Maintain clean and organized facilities (10).

11. Provide prompt and thorough reports of accidents including written reports by instructor, written accounts by witnesses, photographs of accident scenes and conditions, and the standard accident report form (34).

12. Require that students receive the required safety instruction prior to working in the laboratory/shop (34).

13. Be aware of the specific safety needs of special needs (disadvantaged and handicapped) students.

14. Actively cooperate and participate in all possible phases of the school safety program (21).

15. Evaluate student teachers with specific regard to providing for their classes' safety.

16. Regularly inspect laboratory facilities to provide for optimum safety conditions by giving special attention to (48):

    a. layout of equipment and furniture.
    b. utilities and building services.
    c. equipment guarding.
    d. storage and condition of tools.
    e. storage, labeling, handling, and condition of materials.

17. Follow fire safety requirements and procedures (10).

18. Follow electrical code requirements (10).

19. Use accepted industrial safety standards (10).

20. Correct and/or report unsafe conditions (10).

21. Recommend needed safety improvements to the school's administration (19).

22. Assist school administrators in selecting equipment for school use (38).

23. Insist that guards meeting accepted standards be provided and used whenever a machine is operated (34).

24. Insist that adequate eye protection be worn (during laboratory operation and in other potentially hazardous areas)(48).

25. Provide proper protective equipment, and insist on its use, in all shop areas.

26. Require students to wear proper clothing and adequate hair protection while working in the laboratory (48).

27. Develop specific safe practices, rules, and regulations relating to your facilities and provide for their enforcement(34).

28. Give instruction on potential hazards and accident prevention specific to the particular laboratory and course of study involved (48).

29. Incorporate safety instruction (dealing with the proper use of all tools, machines, equipment and materials) in the formal course of study (34).

30. Insure that all course activities are in the school's approved course of study.

31. Record each student's attendance, safety instruction received, and his/her safety evaluation results.

32. Periodically retest students to insure maintenance/retention of specific safety competencies.

33. Become aware of all types of emergency and disaster procedures, developments, and information (21).

34. Keep current on safety developments in field (19).

35. Participate in safety training programs, such as first aid, civil defense, and other relevant safety courses (21).

36. Request assistance from the school safety coordinator when needed (21).

Student Responsibilities

1. Abide by the safety rules and observe safety practices at all times (47).

2. Assist in evaluating and updating safety procedures (47).

3. Recognize personal limitations (47).

4. Assist in maintaining equipment in safe working order (47).

5. Keep work areas clean (47).

6. Use proper dress, guards, and protective equipment (47).

7. Follow instructions and indicate when they are unclear (47).

8. Report unsafe conditions to the instructor or supervisor (47).

9. Be considerate of other students in order to prevent their injury through unsafe actions (19).

10. Give proper attention to safety instruction (19).

11. Be informed and prepared to handle an accident, emergency, or disaster (21).

12. Develop sense of responsibility for personal safety (21).

13. Acknowledge safety instruction received.

COMMUNITY RESPONSIBILITIES

Cooperative Education Employers Responsibilities

1. Provide and maintain appropriate facilities, tools, and equipment to assure employees a safe and healthful place to work (46).

2. Comply with State Board of Education safety and health recommendations (46).

3. Comply with State Industrial Commission safety and health orders (46).

Employee [Students involved in cooperative education] Responsibilities

1. Follow all employer safety and health standards and rules.

2. Wear or use prescribed protective equipment.

3. Report hazardous conditions to your supervisor (employer) and your vocational coordinator.

4. Report any job-related injuries or illnesses to your employer and coordinator.

5. Comply with appropriate Occupational Safety and Health Standards.

Parent Responsibilities

1. Support and cooperate with instructors in encouraging students to respect and comply with the safety laws and regulations (46).

2. Participate in expanding safety educational experiences and cooperate in carrying out subsequent action programs developed for the district (21).

3. Review practical arts and vocational technical education's safety program and indicate recommended additions and/or perceived problems.

4. Indicate to practical arts and vocational technical education faculty your recognition of risks inherent in vocational activity.

Chapter 3 Liability

School liability is very difficult to treat because there are certain areas where the school is immune from liability and others where liability, as determined in a court of law, is decided on the basis of opinions and circumstances (fact). Liability as a result of school officer and/or employee negligence can range from contractractual or a violation of a statute to litigation resulting from negligence. Since schools operate through the medium of individuals--that is, school officers and employees--this chapter discusses liability with this in mind first. Then it treats insurance as it protects the schools and school employees, and finally Missouri's statutory requirements are summarized.

POTENTIAL LIABILITY OF EDUCATIONAL PERSONNEL

Administrators

The administrator should not assume that just because he/she was not present when a student injury occurred that he/she cannot be held liable in a tort suit which might ensue. In fact, two recent court cases illustrate that administrators may be liable for negligent supervision or failure to provide supervision.

- The Minnesota Supreme Court held a principal negligent in part for an injury sustained by a student in a physical education class. The court reasoned that the principal failed to exercise reasonable care in supervising the development, planning, and administration of the school's physical education curriculum and in supervising the inexperienced physical education instructor.[a]

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*Because of the nature of this chapter, specific footnotes will be designated by letter. This will enable direct reference to the source cited.

Additionally, readers should note that this section's contents describe the best available interpretations, inferences, decisions, and information available to the research team, and as limited by the extent of the grant. Furthermore, because of the complexity of law and because the courts, of course, are the sole interpreters of it, practical arts and vocational technical educators concerned with legal issues should always seek competent legal counsel to validate the applicability of the impressions generated by this guide to the specifics of their own situation.

The services of Mr. Paul Kinder, Supervisor, School Law section of Missouri's Department of Elementary and Secondary Education, in preparing much of this chapter are also appreciatively acknowledged.

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[a]Larson v. Independent School District No. 314, Braham, 289 N.W. 2d 112 (MN). 1979.

- The Missouri Court of Appeals, Southern District, stated in a recent decision that, "Supervisory public school employees and teachers are not immune from tort liability for inadequate supervision of their students but such liability is highly subjective and scope of their duties extremely narrow."[b] (Emphases added)

In light of these and other court decisions, it should be apparent that the administrator should be aware that he or she must become actively involved in the development and implementation of a safety policy for his or her building or buildings.

Teachers

Because of the presence of power equipment and machinery in most practical arts and vocational technical education laboratories and classrooms, the potential for injury is even greater than in regular classrooms. Therefore, vocational instructors must be especially aware of the liability he or she could face if a student were injured in the classroom or laboratory. Unlike some other states, Missouri provides little statutory protection for teachers. For example, the sovereign immunity statutes of the state apply only to school districts (not employees) and other political subdivisions. Under these statutes a school district is immune from liability in tort cases except in two specific instances:

- If an employee of the school district is negligent in the operation of a motor vehicle during the course of his/her employment
- If the school district fails to maintain its property in a safe condition

This situation makes it imperative for the vocational teacher to be aware of the different types of circumstances that can lead him/her to a tort liability suit.

> The crucial question then, in actions in tort for damages against teachers is, "What constitutes negligence?" In general, the courts are in agreement that negligence is conduct that falls below the level of that which an ordinarily prudent person would have used under the same or similar circumstances. The first test to determine the presence of negligence is that of foreseeability. This means that, in determining whether an individual is or is not liable, as the result of negligence, the question is, "Could a reasonably prudent person have foreseen that the action in question would have resulted in injury to another?" If so, the actor, by ignoring the foreseeable consequences, is liable for the results of his (her) negligent conduct. In short, it may be stated that the courts will impute negligence to one who fails to act as a reasonably prudent person would have acted under the same or similar circumstances. Thus, it is evident that negligence may result from acts of omission as well as those of commission.[c] (Emphases added)

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[b] Kersey v. Harbin, 591 S.W. 3d 745 (MO). 1979.

[c] Lee O. Garber and Floyd G. Delon, The Law and The Teacher in Missouri (Interstate Printers & Publishers, Inc., 1971), pp. 107-108.

> Needless to say, following the rule just laid down, courts will require that the degree of care required of one, if he/she is to avoid being held guilty of negligence, will be proportionate to the extent of danger involved and the age of the child. For example, it will be expected that teachers will exercise a greater degree of care in supervising children who are exposed to dangerous machinery in a shop (or dangerous chemicals in the laboratory) than they would exercise in supervising the same children in a normal classroom or study hall. Likewise, it will be expected that teachers will exercise a greater degree of care in supervising young children whose judgment has not yet been well developed than in supervising older children with far greater degree of judgment.[d] (Emphases added)

> While courts will hold a teacher liable if he is negligent, they are not likely to hold him liable if the accident or injury was not foreseeable and was unavoidable. Neither will they hold him liable if the pupil is guilty of contributory negligence, i.e., if his conduct was of such a nature that it was primarily, or at least in part, responsible for the injury. Nor will they hold the teacher liable if the pupil was apprised of the inherent danger but elected to assume the risk. For example, a high school tennis coach was not held liable when a member of the tennis team was injured when his glasses were broken by a ball while playing tennis. The court reasoned that the pupil was old enough to realize the danger inherent in playing tennis while wearing glasses, and, by electing to play, he assumed the risk. Finally, it has been held that even if a teacher's conduct may be considered negligent, he will not be liable if the accident or injury resulted from some intervening cause. Thus, it has been held that a teacher was not liable for injuries received by a student while cleaning a dangerous machine in a school shop, where the injury occurred when another student turned on the power. Here, the court ruled that, while the teacher's conduct in asking a pupil to clean a dangerous machine may be considered negligent, the real cause of the accident was an intervening act, the turning on of power by another pupil.[d] (Emphases added)

Student Teachers

In the Minnesota decision entitled Larson vs. Independent School District No. 314, the court ruled that a junior high principal was partially liable for injuries occurring to a student in a physical education class, because the principal had not provided sufficient supervision and information to a new faculty member. Extrapolating from this case it would appear that cooperating teachers bear a heavy responsibility for actions of student teachers. Based on this, two conclusions concerning liability for a student teacher's actions may be drawn:

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[d]Lee O. Garber and Floyd G. Delon, The Law and the Teacher in Missouri. (Interstate Printers & Publishers, Inc., 1971), pp. 107-108.

- A cooperating teacher who leaves a class completely in charge of a student teacher for any appreciable length of time would certainly be in a risk situation.

- A school administrator who approves the absence of a cooperating teacher from the school building for a period of time, leaving the student teacher alone responsible for the students in a classroom, would be in a risk situation.

Consequently, based on these inferences, should a student be injured while the cooperating teacher is absent, it is quite conceivable that both the cooperating teacher and the school's administrators, and possibly even the college/university supervisor, might be held liable.

Protective Measures

Although guarantees are impossible in predicting the outcomes of tort actions, teachers and administrators can operate with increased confidence when they systematically plan and implement a comprehensive safety program. In various publications, Denis J. Kigin, the author of a very valuable book, Teacher Liability in School Shop Accidents, published by Prakken Publications, outlined the principle of Positive Action In essence he felt that liability potential is reduced when teachers:

- provide adequate supervision and are in the classroom at all times when class is in session.

- act as a reasonable and prudent parent would act under the same or similar circumstances.

- instigate a comprehensive safety program and rigidly enforce all rules and regulations.

- provide adequate instruction in the use of all machines, tools, and equipment.

- insist that guards which at least meet industrial standards be provided for each machine and demand that they be in position and used whenever a machine is in operation.

- insist that eye protection be provided and worn in all areas in which there is even a remote possibility of an eye injury.

- insist that adequate safety protective equipment be provided and caution pupils themselves to wear proper clothing in the shop.

- provide a safe working environment by maintaining the entire physical facility in safe working order.

- clearly label and provide proper storage for all toxic and inflammable materials.

- correct known dangerous and defective conditions or, clearly mark them and report them to the designated authority.
- exercise intelligent reasoning in the selection of activities in which pupils are expected to participate.
- provide the proper example for pupils by virtue of words, deeds, and action.

INSURANCE

Institutional

"In Missouri the courts follow the common law rule of immunity of school districts."[e] In a recent case brought by a pupil who was injured as the result of the alleged negligence of a teacher, the court, under the doctrine of sovereign immunity refused to hold the district liable.[f]

School districts generally carry insurance on school buildings and on school buses to lower potential replacement costs and liability costs resulting from an accident. However, in the case of negligence of a school official, "it is a long established principle of common law that the state is not liable in damage for injuries resulting from the negligence of its officers, agents and employees."[g] Because school districts are agencies or arms of the state, it has been held that the school also has immunity. For these reasons, the school has little need for liability insurance covering negligence by the school. Schools however may provide liability insurance for teachers as a benefit.

Students

Because students are typically minors, their coverage in terms of medical expense is more significant than their own liability coverage. However, students cannot be required to purchase medical insurance. Such coverage however is something that parents might wish to consider since vocational students will, in most instances, use power tools and equipment that through a student's own negligence could result in an accident. In cases where parents do not already have medical insurance on their sons and daughters, special insurance is available (for purchase) to cover students during school time. Parents of practical arts and vocational technical education students are encouraged to obtain medical coverage of some type to protect their offspring as well as the instructors from the aggravation of needless court action.

Along a similar vein, Section 162.063, RSMO,[h] states that if a school board declares an activity hazardous, it can then use district funds to purchase protection for students whose parents cannot afford

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[efgh] Lee O. Garber and Floyd G. Delon, The Law and The Teacher In Missouri. (Interstate Printers & Publishing, Inc., 1971), pp. 107-108.

[h] Missouri Insurance Guide.

to pay for such protection. To do this, however, the district must award such a contract on the basis of competitive bids.

Faculty

The school, as indicated in the preceding institutional section, has immunity from tort liability but notably its officers, agents, and employees do not have this immunity. To simplify matters, the following section will refer singularly to teachers and administrators as "faculty".

The best single protection faculty have is a knowledge of the law. "In addition to a knowledge of the law, one should be protected from liability by carrying liability insurance. At this time, characterized by an increasing number of actions for damages being brought by injured parties, one can hardly afford to be without its protection."[i]

It would seem desirable, even if only for their own peace of mind, for faculty to secure liability insurance. Insurance may be purchased from professional organizations and/or commercial insurance companies. Some liability coverage may be available through homeowners insurance. Alternatively, schools may wish to provide group protection as a benefit. In any case, it appears to be desirable to have insurance that provides liability protection for teachers, administrators, and other school employees. Furthermore, when such coverage exists, all parties covered should be provided with a description documenting the details of such coverage.

INSURANCE RELATED STATUTORY REQUIREMENTS

School districts should develop policies and procedures which comply with Missouri Statutes, and the interpretations that derive from them, as they apply to school insurance and safety. In some cases, the Statutes appear to be permissive rather than strictly definitive. It is recommended that the advice of a knowledgeable legal consultant be used in establishing a comprehensive insurance program for a school district. To assist in this task, the following section includes those statutes and Attorney Generals' opinions which affect insurance programs of Missouri's school districts.

Care and Keeping of School Property

The district should endeavor to maintain proper and adequate insurance coverage as is inferred in the Missouri Statutes referring to school property. (Sections 161.122 and 177.031, RSMO.)

Non-assessable Mutual Companies

The district should deal only with the non-assessable type of mutual companies if mutual companies share in the school system's insurance coverage. (Attorney General's Opinions, January 7, 1937, and June 5, 1941.)

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[i] Lee O. Garber and Floyd G. Delon, The Law and The Teacher in Missouri. (Interstate Printers & Publishers, Inc., 1977), pp. 125.

If Bids Are Taken

If bids for insurance coverages are solicited, school officials should utilize open competition to determine who carries its insurance; also the Board should accept the lowest responsible bid. (Attorney General's Advisory Guidelines, July 12, 1973.)

LEGAL STATUS OF LIABILITY COVERAGE IN MISSOURI

School officials should have a clearly defined, written and legally defensible policy on liability coverage. The following factors should be considered in developing such a policy:

School Boards and Immunity

A primary responsibility of school boards and school administrators is safeguarding pupils who are enrolled in the district's schools as well as safeguarding school employees, faculty, and others who have occasion to be on the school premises. An employer's liability is generally restricted because of the Workmen's Compensation laws which exist in some manner in all states. However, there is no consistency of law concerning injury to persons other than employees. Hence the liability, of school districts and their employees, for such injuries varies from a high degree of immunity in some states to broad statutory liability in others. Furthermore, in the absence of legislation, in some cases immunity has even been abrogated by court mandate.

Missouri Specifics

This state's courts have consistently held that municipalities and school districts have sovereign immunity from liability charges due to the fact that they are political subdivisions of the state. Following are cases cited in the Missouri Attorney General's Opinion Number 312 issued on November 4, 1970. Also, the Attorney General's conclusion based on these cases is provided.

Liability depends on the type of function. This distinction between public corporations and municipal corporations was described by the Missouri Supreme Court in Cullor v. Jackson Township, Putnam County, 249 S.W. 2d 393, 395 (MO 1952):

> ...it is important to bear in mind the distinction between municipal corporations (in the strict and proper sense), such as cities, towns and villages, and quasi-corporations, such as counties and townships. Municipal corporations exercise both governmental and propriety (sometimes called corporate) functions. Their liability or non-liability in tort depends on the character of the particular function involved as being governmental on the one hand, or proprietary on the other.

The court held that the defendant was not liable because it was a political subdivision citing the following from Cassidy v. City of St. Joseph, 247, No. 197, 206, 152 S.W. 306, 309 (1912):

> ...neither the State nor these quasi-corporations consisting of political subdivisions which, like counties and townships, are formed for the sole purpose of exercising pure governmental powers, are, in the absence of some express statute to that effect, liable in an action for damages either for the non-exercise of such powers, or for their improper exercise, by those charged with their execution.... (Emphases added)

Because a political subdivision is formed only to perform "governmental" functions, all functions it is authorized to perform must be "governmental" functions. This idea is so strongly entrenched that the courts only discuss "proprietary" versus "governmental" functions when a municipal corporation is involved. For example, see Todd v. Curators of University of Missouri, 374 MO 460, 147 S.W. 2d 1063 (1941), where the court held a political subdivision was not liable in suits for negligence arising out of the performance of a governmental function. The court did not go on to discuss the possible result if the political subdivision was performing a "proprietary" function, apparently assuming that whatever a political subdivision does is a "governmental" function. In fact, in a more recent case on the liability of a school district for negligence, Smith v. Consolidated School District No. 2, 408 S.W. 2d 50, 54 (MO en banc 1966), the court merely said:

> ...for more than a century the courts of Missouri have informally held generally that political subdivisions of the state are not subject to liability in suits for negligence. (Citations omitted.) School districts are political subdivisions of the state. Art. X, Section 15, Constitution of Missouri, V.A.M.S. Section 70.210, RSMO 1959, V.A.M.S. As such, school districts have long been held immune from liability in tort for negligence...

The court in the Smith decision dropped the "in performance of a governmental function" qualification used by the earlier courts and appears to have given school districts a blanket immunity against negligence. This might be overstating the rule because the court was discussing a request to abolish the doctrine of sovereign immunity; however, it supports the conclusion that school districts are immune from liability for negligence when performing functions which are authorized by statute.

All functions which a school district is authorized to perform are "governmental" functions, and the school district is not liable for its negligence while performing those functions. Therefore, a school district may not expend public funds to purchase liability insurance to protect itself from liability resulting from authorized functions of the district such as allowing its swimming pool and auditorium to be used by non-profit organizations, repairing automobiles in a district's Vocational-Technical School, and licensing concessionaires at athletic events. This view was recently reinforced by two cases concurrently decided where the Missouri

Supreme Court, in 4-3 decisions, again upheld the doctrine of governmental immunity long enjoyed by school districts. The suits were entitled Alexander Rennie and Tessie Renner v. Belleview School District (and its directors) and O'Dell, et al., v. School District of Independence. The decisions were handed down March 10, 1975.

Workmen's Compensation

The district should carry Workmen's Compensation according to statutory requirements in Chapter 287, RSMO. Section 287.280 of RSMO mandates that school districts must carry Workmen's Compensation insurance or be self-insured so that benefits comparable to those available under Missouri Workmen's Compensation Statutes are available to district employees. Such self-insurance plans must be comparable to Missouri Workmen's Compensation and must be approved by the Missouri Division of Workmen's Compensation, Jefferson City. The Division of Insurance has the responsibility to collect necessary premium tax as well as the second injury fund assessment from self-insurers.

School administrators, instructors and employees should note that under Workmen's Compensation Insurance there are three occupational categories which are separately rated. These categories include:

1. teachers, administrators, nurses, clerical staff, etc.

2. drivers and related helpers.

3. all other employees, not elsewhere or otherwise classified.

Insurance Program Open for Inspection

School officials should maintain the total insurance program open for inspection according to 610.010 - 610.030 of RSMO.

Chapter 4 Safety Program Recommendations: Actions

This chapter is organized to provide practical arts and vocational technical education instructors with details that are essential to effective safety programs. As such, it contains recommendations for:

- instructor actions pertaining to
  - instruction (course of study and methodology)
  - evaluation (student testing)
  - recordkeeping (documentation)
  - inspection (facility analysis)
  - organization and approval (of overall safety program)

- physical provisions, including
  - laboratory/shop facilities
  - equipment and guarding
  - personal protective equipment

- special considerations pertaining to
  - disadvantaged students
  - handicapped students
  - students from other targeted populations

Throughout this section, the overall safety hierarchy must be kept in mind. In the business and industrial world this means that a situation is first engineered for safety; then remaining hazards are guarded against; education to prevent and avoid accidents is subsequently provided; and finally personal protective equipment is supplied to further reduce vulnerability. Practical arts and vocational technical education administrators and instructors are well advised to emulate this private sector practice by:

- specifying and securing only thoughtfully engineered safe machines, equipment and facilities.

- carefully guarding against existing hazards with systematically engineered devices.

- incorporating a comprehensive safety instructional program into the overall course of study.

- providing, and requiring the use of, necessary personal protective equipment, of appropriate design and quality, in sufficient quantity.

INSTRUCTION

Introduction

Instructors of practical arts and vocational technical subjects know full well their responsibilities for the safety of their classes. Because students are often minors, and because in all cases, they are presumed to have incomplete mastery of the skill, knowledge, and attitudes associated with the subject being pursued, their instructors must

provide for the careful development of those competencies necessary to operate safely in the laboratory, shop, or on the training site. Simply stated, this means that instructors must provide safety instruction. Furthermore, this instruction must embody the characteristics of being:

- systematic (thorough coverage).
- performance based (clear evidence of accomplishment).
- reinforced periodically (repetition to counter forgetting).
- documented (recorded on paper for others to review).

Content and Objectives

The safety instructional program employed by vocational instructors needs to be based on an analysis of known safety hazards, job requirements, standard precautions, and the like. To identify the content that must form the core of a safety program, instructors must access a large number of safety standards specific to their subject area. Careful selection is necessary to achieve student mastery of three vital objectives:

- To recognize existing and potential hazards
- To understand appropriate defense/avoidance and/or prevention strategies
- To be able to act in time

In all cases, instructors are faced with the decision as to what content to build into the safety instruction. Another important point is to identify which should precede all other work and which will be infused throughout the day-to-day instructional activity. It is recommended that instructors approach this decision by identifying the prerequisite knowledges, skills and attitudes that are necessary to the safe functioning of students during their early learning activities. These need to be mastered before any laboratory experience begins.

Following this, the safety knowledges, attitudes, and skills that are needed for subsequent activities must be built into the regular day-to-day instruction. In this way, students are not presented with an artificial dichotomy between "work" and "safety."

The safety program's instructional content needs to be carefully documented, both for purposes of effective initial organization as well as for the record. Both protect the instructor in the event of liability claims. Because it should be readily identifiable as a free-standing component of any practical arts and vocational technical education course, the safety program needs to be developed with its own goals and objectives, its units of instruction, and of course, its own lesson plans. Although instructors are encouraged to infuse as much safety instruction as possible into their "regular" instruction, in order to insure thorough treatment, it is recommended that they:

- identify the safety content necessary to operate safely in the area being taught.
  - knowledges needed
  - attitudes desirable
  - skills required

- write the goals and objectives for the safety program.

- organize the safety content into units of instruction that encompass logical topics.

- detail each unit of instruction by identifying lesson plans to be taught in each unit.

Once the overall course safety content is developed and organized, then instructors need to decide how to infuse the content throughout the course of instruction. Typically, the identification of prerequisite skills and competencies will result in an introductory safety unit that precedes most course instruction but that typically comes after the introduction to, and overview of, the course. For the remaining safety content, instructors are encouraged to assign each safety topic/lesson to the appropriate unit of the normal course of instruction. In this way, instructors may be confident in not having overlooked any vital safety consideration in their overall course activity.

Suggested Instructional Techniques

As with all instruction, safety instruction is more effective when a variety of approaches are employed. Instructors must be careful to tailor their approaches to the objectives being addressed. Because a comprehensive safety program provides for performance and attitudes in addition to knowledges, the methods used must be selected appropriately. Furthermore, instructors are invariably faced with the task of not only teaching the necessary content once, but also of:

- providing remedial safety instruction when students are not able to demonstrate the desired behavior after initial instruction.

- providing back-up instruction to those students that were not in attendance during the original instruction.

- providing reinforcement instruction to bring students back up to a level of performance previously attained but now forgotten.

Review of most available state safety guides has resulted in a list of recommended instructional methods. These include:

1. Develop a permanent safety consciousness in students through teacher example--always doing things the safe way.

2. Teach accident prevention with a positive approach--stressing the right way to perform an operation.

3. Give demonstrations emphasizing the safe use of hazardous tools, utensils, machines, equipment, and materials.

4. Provide instruction on what to do in case of a shop accident.

5. Use information sheets dealing specifically with the safe use of tools, utensils, machines, equipment, and materials.

6. Give periodic demonstrations on the proper use and care of personal protective devices.

7. Provide each student with the general safety rules of the shop, laboratory, or learning site.

8. Provide instruction in the maintenance of tools, utensils, machines, and other equipment.

9. Demonstrate the safe methods of lifting and/or moving heavy items.

10. Use a bulletin board for safety bulletins, safety posters, and safety rules and regulations. Change eye-catching features regularly.

11. Periodically use discussion time to emphasize the importance of each student's acquiring the proper attitude towards accident prevention.

12. Conduct field trips to industrial plants, work sites, and business to study safety practices.

13. Send letters to parents when a student has exhibited a great degree of interest in safety or when he/she has successfully applied safety practices to handle a vocational situation.

14. Require all beginning students to make a careful study of hazards in the shop/laboratory during the first few days of the course.

15. Provide for visiting speakers from business and industry to speak on occupational safety and health practices.

16. Provide a safety suggestion box for student use.

17. Prepare a written safety education program for the shop--similar to a course of study, and allow student access to it.

18. Require each student to sign information sheets dealing with safety rules and regulations to indicate that he/she has read and understood the information. These sheets should be kept on file.

19. Submit the written safety education program for each course to the school administration for their information and approval.

20. Have students participate in accident investigation and reporting.

21. Provide for student involvement in safety inspections of facilities and equipment.

22. Emphasize the link between housekeeping and safety.

23. Provide students with convenient ways to refresh their memory of correct and safe procedures for each assigned activity.

24. Provide work station "prompts," labels, and signs to alert students to appropriate procedures, guards, and personal protective equipment.

25. Role-playing the recreation of an accident often provides useful insights as to its cause.

26. Conduct job safety analyses together with students.

27. During school open houses, emphasize safety by drawing specific attention to safety practices.

EVALUATION

Teaching safety is a very complex and difficult task. It involves the psychomotor, cognitive and affective domains of student behavior in situations where it is sometimes difficult to measure/monitor progress. Because each student is an individual, evaluations should be designed to test students in a variety of ways. Regardless of design the evaluations must reflect the material and objectives presented in the instruction. Of course, evaluation results should be carefully recorded as will be described in this guide's Record Keeping section.

Domain of Testing

The importance of an appropriate relationship between safety instructional objectives and the measurement procedures and techniques used to assess student attainment cannot be overemphasized. Generally, learning outcomes are most appropriately expressed in terms of student behaviors. Therefore, because vocational programs

Figure 2. Critical Incident Technique Sample

Degree of Concern For Safety				
Safety Area Being Rated	Low Safety Concern			High Safety Concern
Housekeeping	Leaves tools and equipment in work area, does not clean work area before or after working.	Replaces tools. Begins and finishes work without cleaning up area where job is being performed.	Cleans up area after job is completed, but is not concerned with problems outside his/her area.	Observes various safety hazards and works to correct them even though they do not affect him/her directly.
Personal Protective Equipment	Has to be reminded to wear safety glasses, aprons, proper shoes etc. several times during the class.	Occasionally fails to use required protective equipment for the job being performed.	Always uses protective equipment, occasionally attempts to clean equipment before or after use.	Uses protective equipment required for each job performed. Performs daily maintenance on protective equipment. Cleans equipment before and after use.
Machines and Equipment	Attempts to adjust machine while it is running. Does not use proper guards and procedure.	Occasionally fails to follow operating instructions for machine. Does think through operations.	Makes sure guards are in place while operating equipment. Reads and follows operating instructions.	Follows safety rules and regulations. Cares for the safety of others while in his/her work area. Informs instructor of safety hazards.

express instructional objectives in terms of what students know; the attitudes they will exemplify; and in terms of the skills (i.e. the ability to perform), the domains of behavior become important guides to vocational instructors. They are also valuable because they specify hierarchies of behavior. Thereby the domains become extremely useful tools in helping vocational teachers identify whether they have specified all of the instructional objectives that should be measured in their courses.

The cognitive, affective and psychomotor domains must be considered in development of safety instruction and evaluation. The cognitive domain includes all objectives that are concerned with the recall of knowledge and the development of higher levels of mental abilities and skills. The affective domain includes those objectives concerned with a student's attitudes and values. The psychomotor domain includes objectives that involve motor skills, the manipulation of materials and objects, and acts that involve neuromuscular coordination. Instructors will need to document safety specific instruction and evaluation in each domain (5, pp. 56-59).

Types of Tests

- Pencil and Paper--A written exam which may be administered at varying intervals after instruction. This could be an examination on general safety rules or on specific safety rules for machines or equipment.

- Observation of Performance--Using a checklist of safety rules/procedures to note whether, or to what extent, students use specific machines and/or equipment according to the manner that was demonstrated.

- Critical Incident Technique--An observation technique that has instructors identify attitudes and/or practices that students should demonstrate. Instructors then specify a series of descriptions (critical incidents) that exemplify the varying degrees to which a student can demonstrate the desired behavior. Rating students then involves observations for a period of time and then recording which of the "critical incidents" occurred--thereby indicating the extent to which the student has demonstrated the desired behavior. Figure 2 provides a sample of a critical incident rating scale.

  Another way to use the technique involves selecting a random sample of participants from various classes within your service area. These students are selected to form a a representative sample. An interviewer (teacher) would then question students who have performed particular jobs within the shop/laboratory. He/she asks the students to describe unsafe acts/errors they have made or observed in the past, or unsafe conditions that have come to their attention. The incidents described by a number of the participant-observers are classified into hazard categories,

from which accident problem areas can be seen. An accident prevention program can then be organized and directed toward these problem areas.

Time of Testing

Essentially there are three reasons to test students for mastery of safety knowledge, attitude, and skill:

- To document that they have mastered sufficient skill and knowledge to permit them to begin laboratory work and then gradually expand their repertoire
- To identify whether they have mastered the necessary skills and knowledge and thereby that they are ready to work with a particular machine or process
- To ascertain that students have retained sufficient amounts of previously demonstrated skills, knowledge, and attitudes in order to permit them to continue with laboratory work

Initial testing of students, the first of the listed purposes, should be completed before students enter the shop/laboratory and before using any machines, equipment, and material. Then gradually additional instruction and testing will establish further skills throughout the course. Subsequently, testing should be used to maintain the safety knowledge of the students. Such examinations could be quarterly or by the semester.

Criterion Levels

All examinations should be criterion-based in order to insure the safety knowledge of students. This means that instructors are advised to establish a minimum passing level that students must attain before being allowed to work in the laboratory and/or use a specific machine. Instructors should note that in contrast to criterion-based grading, normative grading, which is based on comparisons of students, one to another, would not ensure mastery of safety content if for example an instructor were faced with a less than able class.

Within criterion-based assessment, however, there is still room to divide safety knowledge into two major categories:

1. Absolutely Needed--That knowledge or skill which students must be able to master in order to qualify as an operator for a particular machine, piece of equipment, or process.

2. Desirable--That knowledge or skill which students can demonstrate by attaining an acceptable score on the examination. The degree of acceptability should be set by the instructor in accordance with what a reasonable and prudent person could be expected to know in order to avoid being injured.

Reliability and Validity of Examinations

In order to develop and maintain valid and reliable examinations for evaluating the safety knowledge of students, instructors should carefully analyze the evaluation instruments. To aid in this, instructors can use the following approaches:

1. Advisory Council--Provide advisory council members with copies of examinations and other evaluation forms. Ask members to critique the examinations and recommend revisions.

2. Other Teachers--Exchange examinations with other teachers who are teaching the same courses as you. Review the techniques they use and if appropriate, implement them into your program.

3. Item Analysis--Perform an item analysis on your examinations in order to remove and/or revise questions which are not pertinent to the objective of the evaluation.

Qualifying on Equipment/Machines/Tools (18)

1. Initial Orientation--Orientation involves the familiarization of students with a piece of equipment and its uses. Parts are identified and adjustments explained to the students as are the safety features. Safety should be an integral part of the orientation as well as through the remainder of the instruction.

2. Demonstration--The instructors show proper use of the equipment/operation by proceeding through the following steps: (a) preparation (b) operation (c) shut down.

   When demonstrating operations and/or skills, the following suggestions are appropriate to maximize safety instruction (12, p. 28):
   a. Be sure that all students can observe the demonstration.

   b. Emphasize the positive aspects of safety involved in the operation, while at the same time pointing out possible dangers involved to students.

c. Be sure to provide students an opportunity to ask questions concerning "what" is to be done and how it is to be done.

d. Review the material presented, going through the steps one by one so as to clarify any doubts students may have as to how the operation is performed.

e. Review the safety suggestions or practices pertaining to the skill and/or operation.

3. Safety Check--All students must pass a safety exam before being allowed to use any power machinery. The exam is used to measure their knowledge regarding the machine and its safe operation. If a student fails the exam, the missed questions should be reviewed with the teacher and perhaps reinforced through review of the demonstration steps. If wording of the exam questions seems confusing, then it may be necessary to have an individual oral exam, which should be documented and signed. (See Evaluation Section). A unit of Power Tool Safety and Operation including a student manual, activity suggestions, 24 different safety exams and transparency masters, may be quite useful for some vocational instructors. The unit is available from the Instructional Materials Laboratory (see National Agency listing in this manual).

4. Student Performance--The student is allowed to use the machine for the first time under the supervision of the instructor. The teacher guides the student through the operation and corrects any unsafe acts--until he/she is satisfied with the student's safe performance. After a student successfully performs he/she will be qualified to operate and use the particular machine.

5. Qualification Completed--After a student has qualified on a machine or piece of equipment, it will be recorded and made a part of his/her lab file.

RECORD KEEPING

It is absolutely essential for practical arts and vocational technical education instructors to keep safety-related records. One main objective for this is to call attention to accident areas/processes so that steps may be taken to correct an unsafe condition. Records may also be used to protect an employee (instructor) and/or the employer (administrator and board) if either are required to provide evidence of instruction or use of proper safety procedures. Additionally such records assist instructors in tracking student progress and subsequently tailoring instruction to meet individual needs (46, p. 62).

Recommended Procedures (19, p. 16)

- Require each student to sign information sheets dealing with shop/laboratory safety rules and regulations to indicate that he/she has read and understood the regulation. A copy of the information sheets should be kept on file and students should keep the original along with relevant instructional material.
- Require students to demonstrate appropriate levels of proficiency on safety tests before using equipment. Subsequently, students should have to sign their names on each test and thereby indicate that they have received instructions and passed the safety examination.
- Retain all safety information sheets and tests in student safety file in instructor's office.
- Prepare classroom chart to indicate safety instruction given, date of instruction, student attendance and safety test performance.
- Prepare and file an appropriate accident report form for each injury requiring treatment.
- Keep records for a period of time as advised by school counsel.

Acknowledgement Forms

A form that can be used to demonstrate in writing that a student did receive safety instructions is presented in Figure 3. Note that each machine in the laboratory can be listed along with the date the student passed performance evaluation. The purpose of this form is to document that each machine was demonstrated to every student, that each student operated the machine safely, and that the student reinforced his/her responsibility by signing the sheet.

Figure 3

COURSE NAME _____ STUDENT NAME _____

SCHOOL YEAR _____

ACKNOWLEDGEMENT OF SAFETY INSTRUCTION

I have received SAFETY INSTRUCTION on the equipment listed below and I have passed the related SAFETY EXAM.* I fully understand the importance of the safety instruction and the proper operating procedures and that the violation of any one of them may be dangerous to myself and others.

My teacher has demonstrated to me the proper methods and safety precautions regarding the equipment listed below. I have qualified as an operator by demonstrating my ability to safely work with the equipment under the supervision of my teacher.

I am confident that I can operate the equipment safely and that I will report any unusual conditions or defective parts to my teacher immediately. If I am in doubt about any adjustment or operation of any equipment I will have the teacher check it out before proceeding with any work.

DIRECTIONS:

List each equipment below and include the date and your signature after you have received safety instruction, passed your safety exam* and demonstrated your ability to use it.

Name of Machine	Date	Student's Signature	Teacher's Initials
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

*If you are having difficulty in understanding the safety exam and relating it to the equipment, ask your teacher if he/she can allow you to point out your answers on the machine. This may be allowed only with the teacher's permission.

W. S. Marple, Safety Education Program for Industrial Arts. Pennsville Township Schools, New Jersey, (18).

Accident Reports

Accident reports are an essential part of a good safety program. They help to inform, educate, and remind people of what to look for in regard to accident prevention. They also provide an important record of safety infractions and safety precautions. The following procedure is one that could be employed.

1. Fill out the accident report form within twenty-four hours of the incident. This guards against details that may become vague after a few hours have passed and that may thereby affect the report's accuracy.

2. Prepare your report in duplicate. One should be hand-delivered to the principal (or supervisor) and another should be kept in your personal file.

3. Include information on the basis of how, where, what, who, when, and why the accident happened in reconstructing the sequence of events.

4. The U. S. Department of Labor has recommended that the following principles should be observed in preparing reports:

   a. Use common sense--Stick to the facts, weigh their value, reach justified conclusions.

   b. Investigate each clue--Apparently reasonable conclusions will often be changed by exploring factors which initially may not appear to be important.

   c. Check for unsafe conditions and facts--Both are present in the great majority of accidents.

   d. Make recommendations--No investigation is complete unless corrective action is suggested and carried out.

   e. Investigate all accidents--Chance is often the sole difference between a trivial accident and a serious one. Results cannot be predicted.

Figure 4 presents a Standard Student Accident Report Form developed by the National Safety Council. This form is straightforward yet it obtains a large amount of data to document an accident effectively. It is also a very efficient method that yields data for the summary report that should be developed at least annually. An example of one type of accident summary form is shown in Figure 5. Note that this form organizes data so that corrective actions can be taken to prevent recurrence of accidents.

Figure 4

Reproduced through the courtesy of The National Safety Council.

STANDARD STUDENT ACCIDENT REPORT FORM

Part A. Information on ALL Accidents

1. Name: _____ Home Address: _____
2. School: _____ Sex: M ☐; F ☐. Age: ____ Grade or classification: ____
3. Time accident occurred: Hour _____ A.M.; _____ P.M. Date: _____
4. Place of Accident: School Building ☐ School Grounds ☐ To or from School ☐ Home ☐ Elsewhere ☐

5. NATURE OF INJURY

Abrasion	____	Fracture	____
Amputation	____	Laceration	____
Asphyxiation	____	Poisoning	____
Bite	____	Puncture	____
Bruise	____	Scalds	____
Burn	____	Scratches	____
Concussion	____	Shock (el.)	____
Cut	____	Sprain	____
Dislocation	____		
Other (specify)	_____		

PART OF BODY INJURED

Abdomen	____	Foot	____
Ankle	____	Hand	____
Arm	____	Head	____
Back	____	Knee	____
Chest	____	Leg	____
Ear	____	Mouth	____
Elbow	____	Nose	____
Eye	____	Scalp	____
Face	____	Tooth	____
Finger	____	Wrist	____
Other (specify)	_____		

DESCRIPTION OF THE ACCIDENT

How did accident happen? What was student doing? Where was student? List specifically unsafe acts and unsafe conditions existing. Specify any tool, machine or equipment involved. _____

6. Degree of Injury: Death ☐ Permanent Impairment ☐ Temporary Disability ☐ Nondisabling ☐
7. Total number of days lost from school: _____ (To be filled in when student returns to school)

Part B. Additional Information on School Jurisdiction Accidents

8. Teacher in charge when accident occurred (Enter name): _____
   Present at scene of accident: No: _____ Yes: _____

9. IMMEDIATE ACTION TAKEN

First-aid treatment	____	By (Name): _____
Sent to school nurse	____	By (Name): _____
Sent home	____	By (Name): _____
Sent to physician	____	By (Name): _____
		Physician's Name: _____
Sent to hospital	____	By (Name): _____
		Name of hospital: _____

10. Was a parent or other individual notified? No: __ Yes: __ When: _____ How: _____
    Name of individual notified: _____
    By whom? (Enter name): _____
11. Witnesses: 1. Name: _____ Address: _____
    2. Name: _____ Address: _____

12. LOCATION

	Specify Activity		Specify Activity
Athletic field	_____	Locker	_____
Auditorium	_____	Pool	_____
Cafeteria	_____	Sch. grounds	_____
Classroom	_____	_____ shop	_____
Corridor	_____	Showers	_____
Dressing room	_____	Stairs	_____
Gymnasium	_____	Toilets and washrooms	_____
Home Econ.	_____	Other (specify)	_____
Laboratories	_____		

Remarks

What recommendations do you have for preventing other accidents of this type? _____

Signed: Principal: _____ Teacher: _____

Figure 5

SCHOOL ACCIDENT SUMMARY FORM

Period From _____ Page of _____

To _____ School _____

Case No.	Name of Injured Person	Date of Injury	Location of Accident (area)	Nature of Injury	Part of Body	Source of Injury	Tools & Equipment used	Time Lost	Hazardous Condition	Human Error	Instructor/ Supervisor	Compensation	Medical Costs	Other Costs
79-1	William Smith	9/8/79	Wood Working Shop -- Table Saw Area	Lacer-ation	Left Hand	Saw Blade	Table Saw	1/2 Day	Unguarded Saw Blade and Slip-pery Sur-face	Failure to check with institution and failure to clean area in proximity of saw	Mr. Yardley	n/c	$ 35.00	$100.00

*Adapted from Firenze, Robert J. Safety and Health in Industrial/Vocational Education, p. 6.41 1980.

Additional information pertaining to student accident reporting is available from the National Safety Council. They have made available, to all school districts that enroll 300 students or more, the Student Accident Reporting Guidebook. This accident reporting guidebook can be obtained by writing to the National Safety Council, at the address located in the resource section of the safety guide.

Summary

An effective and efficient reporting system is one which provides pertinent information about all students in all program areas and by which all accidents can be recorded and analyzed with a minimum of time and effort. Specialization areas sometimes feel that a comprehensive reporting system is too general and therefore does not yield the detailed information necessary for realistic analysis. This need not be so if space is provided for details, and if there are adequate instructions for completing the report form, and if those instructions are followed. Quite often special studies for the shop area of school systems, or a statewide program, will justify a special reporting system as a supplement to the overall system.

INSPECTIONS

A safe environment is an essential part of vocational education's safety program. This safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel-administrators, safety coordinators, insurance and fire personnel, teachers and students, and service area specialists.

Every vocational shop/laboratory harbors some existing potential hazards which arise through changes due to the removal or introduction of machines, materials, processes or teachers. Consequently, inspections are a necessary segment of a complete safety program. Safety inspections are a means of surveying and appraising the problems of unsafe conditions and work practices which result from changes as well as normal deterioration of facilities and equipment.

Reasons for Inspections

There are eleven excellent and specific reasons for conducting safety inspections (9).

1. To reawaken interest in the safety problem.
2. To reevaluate safety standards and policies.
3. To teach safety by specific, tangible example.
4. To make open and conspicuous display of sincerity relative to safety.
5. To detect and reactivate unfinished business.
6. To collect current safety data for up-to-the-minute reporting.
7. To note and act upon unsafe behavior trends.
8. To reach first hand, on-the-spot agreements with responsible parties relative to securing action on safety problems.
9. To improve safety standards.
10. To check new and rearranged facilities for student accessibility.
11. To check the results against the safety plan.

Who Should Inspect?

Part of the answer to "who inspects?" is based upon the fact that, in most cases, there should be more than one type of safety inspection. Depending upon the type of shop/laboratory or circumstances involved in each case, safety inspections by several persons might be necessary. The vocational teacher should be making a constant safety inspection as he/she goes through daily routines -- always alert to changing conditions or work methods. In most cases, teachers need to make hourly checks and inspections to be certain that all safety precautions are in place.

Inspections by the members of a safety committee may reveal hazards which might be overlooked by persons less familiar with the work. Some committees make inspections each month; others may inspect every other month or even once per semester. In all cases, more than one person should make the safety inspections. Typically, the following people are available to offer and perform inspections:

- State Department supervisors
- University professors
- Insurance inspectors
- Local fire department personnel
- State Department of Labor safety specialist
- State Safety Council representatives

Principles of Inspection

There are several factors necessary for effective safety observations. The inspector must (26, pp. 84 and 85):

1. Be selective -- An inspector might look over a department first for safety, second for improvement of operations, third for training needs, and so on.
2. Know what to look for -- The more a supervisor or safety professional knows about a job and a worker's responsibilities, the better an observer he/she will be.
3. Practice observing -- The more often a person looks with the conscious intention to observe, the more he/she will see. Like all skills, observation improves with practice.

4. Keep an open mind -- One way to increase open-mindedness is not to judge facts in advance. The inspector must not deny the fact, no matter what conclusion it may seem to lead to. The inspector must keep his/her mind open, at least until he/she has all the facts.

5. Do not be satisfied with general impressions -- A clean shop/laboratory, or a careful routine, may still contain hidden hazards.

6. Guard against habit and familiarity -- Asking the questions what, where, when, how and (especially) why will often help to uncover the real meaning of the situation.

7. Record observations systematically -- All notes should be dated, with space for comment on action taken and on results of the action. The notebook can serve both as a reminder and as a record of progress.

8. Prepare a checklist -- A systematic check for litter, obstructions, handling of flammables, condition of fire-fighting equipment, and so on, will uncover tangible problems that can be corrected.

Safety Checklists

A safety inspection/checklist is an objective tool to help improve working and learning conditions in the practical arts and vocational technical education laboratory. Using a safety checklist, such as the one provided on the following pages, for the inspection has some advantages over other methods of safety inspection. This list is intended to accomplish the following, to:

- inform, educate and remind persons of key characteristics of safe environments.
- train personnel to be sensitively observant and aware of their environment.
- provide a source of feedback to teachers and administrators that indicates the extent to which they provide a safe environment.
- provide a record of safety items and prevention activity.

Recommendations For the Use of Checklists

1. A safety inspection team should complete a checklist for each vocational education laboratory. The building principal would ideally be a member of the team.

2. The inspection team may arrange for additional assistance from outside agencies to help with safety inspections. Such assistance might be obtained from insurance or fire inspectors, advisory council members, and/or appropriate governmental agencies such as the Missouri Department of Labor Standards.

3. As a minimum, safety inspections should be made at the beginning of every school term or semester. More frequent inspections may be advisable in critical areas.

4. Inspections should be planned in advance and preferably should occur when students will be using the facility.

5. Current inspection results should be compared with previous reports to ascertain progress.

6. Reports should be studied in terms of accident occurrences so that special attention can be given to conditions and locations which are accident producers.

7. In all cases when corrective actions are required, they should be noted and copies forwarded to the proper authorities.

8. Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures and with due regard to the hazard potential of the situation.

9. A conference of the inspection team, the instructor, and appropriate administrators should be held shortly following the inspection of each practical arts and vocational technical facility.

Job Safety Analysis

Just as checksheets are typically used to evaluate a facility, Job Safety Analysis (JSA) is a procedure that identifies the hazards or potential hazards associated with each job that occurs within the facility. JSA then develops solutions that will either eliminate or guard against such hazards. A job can be defined as a sequence of separate steps or activities that together accomplish a work goal. The four basic steps to Job Safety Analysis are as follows (26, pp. 111-114):

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST

Prepared by the Joint Safety Committee of the
AMERICAN VOCATIONAL ASSOCIATION — NATIONAL SAFETY COUNCIL

_____ Date _____

_____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through *regular* and *frequent* inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List, recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students—the student safety engineer and/or student safety committee—participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum, a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

HOW TO INSPECT?

Inspections should be well planned in advance.

Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions.

The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S — Satisfactory (needs no attention)
A — Acceptable (needs some attention)
U — Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local application only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged so as to conform to good safety practices ..... S A U
2. Condition of stairways ..... S A U
3. Condition of aisles ..... S A U
4. Condition of floors ..... S A U
5. Condition of walls, windows, and ceiling ..... S A U
6. Illumination is safe, sufficient, and well placed ..... S A U
7. Ventilation is adequate and proper for conditions ..... S A U
8. Temperature control ..... S A U
9. Fire extinguishers are of proper type, adequately supplied, properly located and maintained ..... S A U
10. Teacher and pupils know location of and how to use proper type for various fires ..... S A U
11. Number and location of exits is adequate and properly identified ..... S A U
12. Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergencies S A U
13. Lockers are inspected regularly for cleanliness and fire hazards. S A U
14. Locker doors are kept closed ..... S A U
15. Walls are clear of objects that might fall ..... S A U
16. Utility lines are properly identified ..... S A U
17. Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building. S A U
18. Air in shop is free from excessive dust, smoke, etc. .... S A U
19. _____ S A U
20. _____ S A U
21. _____ S A U
22. _____ S A U
23. Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION ..... S A U

B. HOUSEKEEPING

1. General appearance as to orderliness..... S A U
2. Adequate and proper storage space for tools and materials. S A U
3. Benches are kept orderly..... S A U
4. Corners are clean and clear..... S A U
5. Special tool racks, in orderly condition, and provided at benches and machines..... S A U
6. Tool, supply, and/or material room is orderly..... S A U
7. Sufficient scrap boxes are provided..... S A U
8. Scrap stock is put in scrap boxes promptly..... S A U
9. Materials are stored in an orderly and safe condition.. S A U
10. A spring lid metal container is provided for waste and oily rags. S A U
11. All waste materials and oily rags are promptly placed in the containers..... S A U
12. Containers for oily rags and waste materials are frequently and regularly emptied..... S A U
13. Dangerous materials are stored in metal cabinets..... S A U
14. Machines have been color conditioned..... S A U
15. Safety cans are provided for flammable liquids..... S A U
16. Bulk storage of dangerous materials is provided outside of the main building..... S A U
17. A toe-board or railing around a mezzanine used for storage or washing facilities..... S A U
18. Materials are stored in an orderly and safe condition on this mezzanine..... S A U
19. Flammable liquids are not used for cleaning purposes S A U
20. Floors are free of oil, water and foreign material..... S A U
21. Floors, walls, windows, and ceilings are cleaned periodically. S A U
22. _____ S A U
23. _____ S A U
24. _____ S A U
25. _____ S A U
26. Evaluation for the total rating for B. HOUSEKEEPING S A U

C. EQUIPMENT

1. Machines are arranged so that workers are protected from hazards of other machines, passing students, etc..... S A U
2. Danger zones are properly indicated and guarded..... S A U
3. All gears, moving belts, etc., are protected by permanent enclosure guards..... S A U
4. All guards are used as much as possible..... S A U

C. EQUIPMENT (continued)

5. All equipment control switches are easily available to operator. S A U
6. All machines are "locked off" when instructor is out of the room. S A U
7. Brushes are used for cleaning equipment..... S A U
8. Nonskid areas are provided around machines..... S A U
9. Machines are in safe working condition..... S A U
10. Machines are guarded to comply with American Standards Association and local state code..... S A U
11. Adequate supervision is maintained when students are using machines and dangerous tools..... S A U
12. Tools are kept sharp, clean and in safe working order S A U
13. All hoisting devices are in safe operating condition... S A U
14. Machines are shut off while unattended..... S A U
15. Adequate storage facilities for tools, equipment, etc., not in immediate use..... S A U
16. _____ S A U
17. _____ S A U
18. _____ S A U
19. _____ S A U
20. Evaluation for the total rating for C. EQUIPMENT.. S A U

D. ELECTRICAL INSTALLATION

1. All switches are enclosed..... S A U
2. There is a master control switch for all of the electrical installations..... S A U
3. Electrical outlets and circuits are properly identified.. S A U
4. All electrical extension cords are in safe condition and are not carrying excessive loads..... S A U
5. All machine switches are within easy reach of the operators. S A U
6. Electrical motors and equipment are wired to comply with the National Electric Code..... S A U
7. Individual cut-off switches are provided for each machine. S A U
8. Machines are provided with overload and underload controls by magnetic pushbutton controls..... S A U
9. No temporary wiring in evidence..... S A U
10. _____ S A U
11. _____ S A U
12. _____ S A U
13. _____ S A U
14. Evaluation for the total rating for D. ELECTRICAL INSTALLATION..... S A U

E. GAS

1. Gas flow to appliances is regulated, so that when appliance valve is turned on full, the flames are not too high..... S A U

2. Gas appliances are properly insulated with asbestos or other insulating material from tables, benches, adjacent walls, or other flammable materials ..... S A U

3. No gas hose is used where pipe connections could be made. S A U

4. Gas appliances have been adjusted so that they may be lighted without undue hazard..... S A U

5. Students have been instructed when lighting gas appliances to light the match first before turning on the gas..... S A U

6. There are no gas leaks, nor is any odor of gas detectable in any part of the shop..... S A U

7. Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure.. S A U

8. When lighting the gas forge, goggles are worn..... S A U

9. When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace..... S A U

10. In shutting down the gas furnace, the gas valve is closed before the air valve..... S A U

11. _____ S A U

12. _____ S A U

13. _____ S A U

14. _____ S A U

15. Evaluation for the total rating for E. GAS..... S A U

F. PERSONAL PROTECTION

1. Goggles or protective shields are provided and required for all work where eye hazards exist..... S A U

2. If individual goggles are not provided, hoods and goggles are properly disinfected before use..... S A U

3. Shields and goggles are provided for electric welding.. S A U

4. Rings and other jewelry are removed by pupils when working in the shop..... S A U

5. Proper kind of wearing apparel is worn and worn properly for the job being done..... S A U

6. Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed..... S A U

7. Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room..... S A U

8. Provisions are made for cleaning and sterilizing respirators. S A U

9. Students are examined for safety knowledge ability.. S A U

10. Sleeves are rolled above elbows when operating machines. S A U

11. Clothing of students is free from loose sleeves, flopping ties, loose coats, etc. ..... S A U

12. _____ S A U

F. PERSONAL PROTECTION (continued)

13. _____ S A U

14. _____ S A U

15. _____ S A U

16. Evaluation for the total rating for F. PERSONAL PROTECTION. S A U

G. INSTRUCTION

1. Shop Safety is taught as an integral part of each teaching unit. S A U

2. Safety rules are posted particularly at each danger station. S A U

3. Printed safety rules are given each student..... S A U

4. Pupils take a safety pledge..... S A U

5. Use of a safety inspector..... S A U

6. Use of a student shop safety committee..... S A U

7. Use of safety contests..... S A U

8. Motion and/or slide films on safety are used in the instruction. S A U

9. Use of suggestion box..... S A U

10. Use of safety tests..... S A U

11. Use of safety posters..... S A U

12. Talks on safety are given to the classes by industrial men. S A U

13. Tours are taken of industrial plants as a means of studying safety practices ..... S A U

14. Periodic safety inspections of the shop are made by a student committee ..... S A U

15. Men from industry make safety inspections of the shop S A U

16. Student shop safety committee investigates all accidents S A U

17. A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area ..... S A U

18. Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate... S A U

19. _____ S A U

20. _____ S A U

21. _____ S A U

22. _____ S A U

23. Evaluation for the total rating of G. INSTRUCTION S A U

H. ACCIDENT RECORDS

1. There is a written statement outlining the proper procedure when and if a student is seriously hurt..... S A U

2. Adequate accident statistics are kept..... S A U

3. Accidents are reported to the proper administrative authority by the instructor ..... S A U

H. ACCIDENT RECORD (continued)

4. A copy of each accident report is filed with the State Department of Education ..... S A U

5. Accident reports are analyzed for instructional purposes and to furnish the basis for elimination of hazards..... S A U

6. _____ S A U

7. _____ S A U

8. _____ S A U

9. _____ S A U

10. Evaluation for the total rating of H. ACCIDENT RECORDS. S A U

I. FIRST AID

1. An adequately stocked first aid cabinet is provided... S A

2. The first aid is administered by a qualified individual S A

3. The school has individuals qualified to administer first aid. S A

4. _____ S A

5. _____ S A

6. _____ S A

7. _____ S A

8. Evaluation for the total rating of I. FIRST AID.... S A

RECOMMENDATIONS

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1. Select the job to be analyzed.

2. Break the job down to be analyzed.

3. Identify the hazards and potential accidents.

4. Develop ways to eliminate hazards and potential accidents.

Step 1. In selecting a job for JSA there are four ways to do it:

- We can take a job that has the highest accident frequency involving injuries or property damage
- Look at jobs with the highest severity potential
- Any job which has produced a major or disabling injury
- Any new jobs that are added

Step 2. Identifying essential components that make up the job. This is facilitated by:

- identifying the steps a worker follows through to the completion of the job in question.
- specifying what happens to material during the job process.
- listing the machines and tools used to complete the job.

Step 3. The hazards and potential accidents must then be identified. To get started, the following questions might be asked:

- Is there a danger of striking against, being struck by, or otherwise making an injury-producing contact with an object?
- Can the individual be caught in, on, or between objects?
- Can the individuals slip or trip? Can he/she fall on the same level or to another?
- Can strains be inflicted by pushing, pulling, or lifting?
- Is the environment hazardous (toxic gas, dust, heat, animals)?

Step 4. Lastly, the steps necessary to control or eliminate the hazard must be developed. The principle solutions are:

- Find a new way to do the job
- Change the physical conditions that create the hazard

- Change the job procedure
- Reduce the frequency with which a job must be done
- Utilize protective clothing or equipment to reduce or eliminate the hazard

Benefits of Job Safety Analysis (9)

- Gives individual training to students
- Helps teacher instruct new students on the job
- Helps to prepare for planned safety observations
- Gives pre-job instructions on irregular jobs
- Helps to review job procedures if accidents should occur
- Provides means of studying jobs for possible method of improvement

Summary

Many details are involved in a good safety inspection procedure, but the points requiring full consideration and development to yield an effective system are quite simple. To produce meaningful results one addresses (9):

1. What is to be inspected?
2. How often is each thing, process, or area to be inspected?
3. Who is to do the inspecting, and what procedures are to be used?
4. Who will supervise inspection activities and how?
5. What reports and records will be needed, and how will they be handled?
6. What provisions must be made for taking corrective action?

ORGANIZATION AND APPROVAL

Several key concepts are essential to a carefully organized and properly endorsed safety program. Most importantly, such a program will exist both on paper and in practice. In other words, a safety program will not exist merely on paper as a compliance document, but it will occur in the day-to-day practice of practical arts and vocational technical education.

Compile Complete Program

A complete safety program will include a wide variety of components.

1. A statement of the educational system's general policy for the safe operation of practical arts and vocational technical education courses. Figure 7 provides a National Safety Council sample of one such policy.

2. A statement of objectives for the overall practical arts and vocational technical education safety program.

3. A content outline of the safety information to be incorporated in each practical arts and vocational technical education course.

4. An outline of the methods used to provide safety education to students in each practical arts and vocational technical education course.

5. A description of the methods and instruments to be used to assess student knowledge, and skills as they relate to safe operation in practical arts and vocational technical education courses.

6. Separate and specific statements of practices and precautions required for safe operation within each individual course.

7. A plan for the periodic inspections and maintenance of facilities, materials, tools, machines, equipment, and personal protective devices (as appropriate) used to provide instruction in each practical arts and vocational technical education course.

8. A staged (time-lined) plan for the elimination of all known hazards and problems.

9. Specification of the emergency procedures for each separate building and classroom (where appropriate), to be followed in the event of an accident/injury involving a student, teacher or other individual hurt in a vocational technical or practical arts facility.

Figure 7

NATIONAL SAFETY COUNCIL SCHOOL SAFETY ADMINISTRATION AND SUPERVISION

The policy below was developed by the "School Safety Administration and Supervision Section" of the School and College Department. It is to be used as a guide for school boards and other interested parties who wish to develop a policy of their own, either to establish new or strengthen existing total school safety programs (27).

Model School Safety Policy

Accidents are undesirable, unplanned occurrences which can be prevented and they often result in bodily harm, loss of school time, property damage, possibly expensive legal action, and even death. Thus, it shall be the policy of the _____ School District to take every reasonable precaution for the safety of the students, employees, visitors, patrons, and all others having business with this school district. The Board of Education believes that safety education and accident prevention are important to everyone concerned with our schools, not only as a protective measure during school hours, but also as an instructional means of developing an appropriate mode of behavior to minimize accidents at all times.

It shall be the responsibility of the district's chief administrative officer to execute this policy. In order to have a comprehensive program which will meet the needs of the _____ School District:

- The responsibility for developing the total safety program shall be delegated to a competent, professional staff person who will be directly responsible to the superintendent.* He/she shall be provided with staff, time, budget, authority and title commensurate with the task.

- This staff person, acting in an advisory capacity to all heads of major units within the district, shall be responsible for the promotion and development of an aggressive accident prevention and safety education program for students and professional and nonprofessional personnel employed by the district.

- The general areas of responsibilities include, but are not limited to, in-service training, development of accident prevention procedures, accident record keeping, plant inspection, driver education, vehicle safety programs, fire prevention, school site selection, emergency procedures and traffic safety problems related to employees, pupils and the community.

Approved by the National School Boards Association
*Approved by the Association of School Business Officials, with the following modification to substitute for the word "superintendent": " . . . assistant superintendent in charge of business, or another administrator of comparable rank, other than the superintendent."
Approved by the Wisconsin School Safety Coordinators Association.
For total safety program information, write to the School and College Department, National Safety Council, 444 North Michigan Avenue, Chicago, Illinois 60611.

10. A description of the record keeping practices to be employed in documenting safety instruction, attendance and control of class movements, and of accidents/injuries that occur.

11. A plan for the ongoing in-service training of instructors in vocational safety-related content, skills, and procedures.

Format

It is recommended that each system and/or program organize their safety programs in a loose-leaf format with tab dividers to reflect each major section as outlined above. Furthermore, it would be advantageous to provide each instructor with copies of the general sections as well as of the sections that pertain specifically to his/her own service area (and courses). In addition, it will be important that one overall complete manual be available in each building.

Approval Procedures

Ultimately, the most significant safety program approval that can exist is that from the Board of Education that governs the system/institution involved. Furthermore, the research team recommends that each board consider itself responsible to review and formally approve a carefully developed, systematic, system-wide safety program. Because boards have a reasonable right to expect that materials presented to them are appropriate and thorough in their content, the following approval sequence is recommended:

1. Hold local instructor and vocational director/coordinator workshop to orient staff to that which is needed, to assign development responsibility and to establish time lines.

2. Hold group meetings, of each service area's faculty, to consolidate the specifics of each area's safety program and to coordinate treatment of safety items in each course within the service area.

3. Request input and revision from the state supervisor responsible for each service area. Advisory council input is also useful at this stage.

4. Hold a system-wide meeting of practical arts and vocational technical education faculty and consolidate service area safety programs with the sections applicable across the board.

5. Prepare a brief outline of the steps used to develop the system's vocational safety program. Then, together with a cover letter from the system's chief vocational administrator, route the complete program outline and cover letter through the superintendent/president to the Board of Education/governors and request formal approval.

Chapter 5 Safety Program Recommendations: Facilities and Equipment

INTRODUCTION

Despite the differences among vocational education's instructional areas, there are also many generalizations that apply across the board to classroom and laboratory safety. This section of the safety guide is devoted entirely to such practical arts and vocational technical education facility characteristics.

There are however, some limitations imposed by a general overview. Specialized areas within vocational education need to have their safety concerns addressed by persons and/or agencies that know the detailed considerations that apply to each area. The following represent useful personnel that can provide and/or refer one to experts with such detailed information.

1. State Supervisor--In the Division of Career and Adult Education each vocational service area is represented by at least one specialist. These persons, because of their day-to-day involvement, can provide valuable advice on many safety related matters.

2. Specialized Resource Personnel--These are individuals who are teaching or otherwise specifically concerned with the service area. Examples include: university, junior/community college and area vocational school faculty as well as representatives from agencies such as those listed in this guide's Useful Information section.

3. Industrial Consultants--Many industries already provide representatives to serve on vocational advisory committees. These and other companies can often supply safety, facility, equipment, and material advice.

Practical arts and vocational technical educators are advised to implement the generalized vocational safety recommendations contained in this guide and also the specialized safety considerations pertinent to each area. Most of the specialized concerns will largely be able to be classified by the categories presented in this guide.

Because of the complexity of the interactions between facility and safety concerns, this chapter was organized to treat the topics of: facility characteristics, i.e., space, housekeeping, laboratory arrangement, exits, storage, provisions, personal services, fire protection, and electrical aspects; environmental factors such as lighting, color, ventilation and noise; machine guarding and materials handling. It is important to note that this information is generalized in nature and hence, the degree to which it applies to each vocational service area varies.

TABLE I

RECOMMENDED SPACE ALLOCATIONS IN SQUARE FEET PER STUDENT*

Vocational Service Area	Course/Specialization	Minimum	Desirable	Missouri DESE Recommendations[a]
Business & Office	Typing (40 students)	25	40	40
	Bookkeeping/General Business[b]	25		25
	Shorthand[b]	25	50	25
	Business Machine/Office Procedures[b]	40	60	40
	Data Processing[b]		80	80
	Departmental Office			50 sq ft/teacher
Marketing & Distributive Education[c]	General Classroom[b]	50	60	42
	Display/Work Storage Area	230 sq ft/area		300 sq ft/area
	Model School Store		720	
	Office & Conference Area	88 sq ft/teacher	144/ teacher	100 sq ft/teacher
Health Occupations			1000+	1000 sq ft minimum plus whatever the national accreditation agencies require.
Home Economics	*Consumer & Homemaking Curriculum *Occupational - On-the-Job Training	A typical home economics classroom shall have adequate space to accommodate the students and the work to be accomplished. Floor area designations may overlap. Contact state supervisor for specific recommendations to meet your program needs.		1-teacher department 2000 sq ft 2-teacher department 2700 sq ft 3-teacher department 3780 sq ft
Industrial Arts[b]	Power Mechanics	75	150	[d]70-85 JHS-SHS
	Metals	75	135	70-85 JHS-SHS
	Woods	80	135	80-95 JHS-SHS
	Plastics	60	100	55-75 JHS-SHS
	Machine	100		
	General	75	135	83
	Electronics	55	110	70
	Graphics	75	135	55-75 JHS-SHS
	Crafts	75	125	75 SHS
	Drafting	40	60	50-75 JHS-SHS
	Ceramics	60	80	55-75 JHS-SHS
	Electricity	60	80	70-85 JHS-SHS
Trade & Industry	Power Courses	180		
	Metals	150		
	Woods	120		
	Plastic Technology	120		
	Welding	120		
	Machine Shop	120		
	General	120		
	Electronics	108		
	Graphics	108		
	Architectural Drafting	60		50 1200 sq ft
	Air Frame Power Mechanics	360		300 7200 sq ft
Vocational Agriculture (15-18 students)	Shop Area	150	200	145
	Soils Laboratory			200 sq ft
	Classroom			44 720 sq ft
	Conference & Office			200 sq ft

*The total area of vocational laboratories is determined on the basis of square feet per student and an assumed class size of 20-24 students. The square feet/student ratio is not valid for very small class sizes in that typically a minimum area is necessary for adequate learning and work.

The recommendations listed were obtained from safety publications issued by the states of Idaho, Missouri, North Carolina, Oklahoma, and Utah.

[a] Recommendations made by Missouri State Department of Elementary & Secondary Education School Building Services.
[b] Based on 20 students/class.
[c] From Organization and Administration of Distributive Education, Crawford and Meyer.
[d] From Planning and Equipping Industrial Arts Instructional Facilities, Missouri Department of Elementary and Secondary Education, revised edition, 1976.

CLASSROOMS AND LABORATORIES

Space Allocation

Maintaining an attractive and safe shop, laboratory, or classroom is an essential part of a comprehensive safety program that supports behavioral change and provides a safe environment in which to work. Adequate space is essential to a safe, comfortable, as well as educationally efficient work and learning place.

Some of the factors that affect space allocation include the number and kind of students, the specific subject area, the amount and kind of equipment, auxiliary facilities and open spaces needed. Laboratories and shops should be built to serve a specific purpose. Industrial or real-life conditions should be duplicated to a degree appropriate to the specific course's objectives and methodology. In designing/renovating practical arts and vocational technical education facilities, economic considerations with respect to construction and maintenance should be considered but not at the expense of safety.

Several important characteristics are relevant to practical arts and vocational technical education space. These are:

1. Size--The total amount of space provided for the facilities should meet the needs of the current program and be adaptable to changes for future programs. Facility size should accommodate:

   a. the number, kind, and flow of students.

   b. the amount, size, and flow of material.

   c. the amount, kind, and size of equipment necessary for instruction.

   Furthermore, facilities should be sized in accordance with Missouri's Department of Elementary and Secondary Education and professional consensus recommendations. Table I provides a convenient summary of these recommendations.

2. Shape--Typically, the best shape of a vocational laboratory is rectangular with 1:1½ to 1:2 ratio. Occasionally a specific course may call for alternate configurations but it is best to do so only with a strong rationale.

3. Height--Optimum height for shops is 12-14 feet with careful considerations of overhead obstructions. The laboratory arrangement paragraph later in this section provides additional details.

Housekeeping

Most safety specialists and competent vocational teachers consider housekeeping to be one of the most important activities in creating an environment relatively free of accident-producing hazards.

Housekeeping means more than keeping the facilities clean and free of undesirable scraps and dirt. It also means orderliness such as an orderly arrangement of tools, equipment, operations, storage facilities, and materials (50, p. 126).

1. Objectives of Housekeeping--Housekeeping in relation to accident prevention has many objectives. Everyone working in the shop or laboratory has a personal responsibility to help prevent accidents by effective housekeeping. Therefore, the objectives of such activity are:

   a. to reduce or eliminate hazards which cause accidents from falls, slips, striking against objects, and falling objects.

   b. to eliminate the hazards from fire through the provision of approved containers, proper storage facilities, and clean-up procedures.

   c. to develop an awareness of the need for housekeeping measures in an accident prevention program.

   d. to develop the desired attitudes towards safe working conditions, practices, and sanitary conditions.

   e. to develop an understanding of the essentials of an effective housekeeping program.

   f. to familiarize students with the responsibilities of housekeeping and to instill in them the desire for clean and orderly surroundings (50, pp. 126 and 127).

2. Responsibilities for Housekeeping--The planning and maintenance of an effective housekeeping program in vocational shops and laboratories is the combined responsibility of administration, teachers, staff, and students. Administrators must recognize that good housekeeping procedures are an important element in the accident prevention program and therefore provide adequate space and custodial service. However, the teacher has the immediate responsibility for the program. Since housekeeping is largely a matter of management and organization, good housekeeping will depend upon the provision of:

   a. adequate storage rooms, areas, shelves, racks, and cabinets for materials and supplies, projects, tools, equipment, and accessories.

   b. suitable containers for scraps, shavings, chips, paper, hair, and other waste material.

   c. splash guards and oil pans on all machines using oil and coolant.

   d. adequate dust collecting and ventilation systems.

e. proper housekeeping instruction and training.

f. proper layout of equipment, traffic areas, aisles, and working areas.

g. adequate housekeeping and janitorial facilities for cleaning windows and shelves (50, p. 127).

3. Good Housekeeping Practices--Good housekeeping cannot be attained by an occasional grand clean-up. If the shop or laboratory is to be kept clean and orderly, an ongoing program must be planned and implemented. Teachers should adopt a policy of locating and correcting conditions that produce congestion, disorder, dirt, waste, trash, and other poor housekeeping conditions. To check on housekeeping practices, teachers may want to develop their own inspection checklists adapted to the needs of their particular facility. The following are examples of good housekeeping practices (50, pp. 127-129):

a. The general appearance of the area is clean, orderly, and well painted, with adequate lighting and ventilation systems.

b. Machinery/equipment is arranged to permit safe, efficient work practices and ease in cleaning.

c. Tools and accessories are safely stored in cabinets, on racks, or other suitable devices.

d. Sufficient waste containers and receptacles are provided in appropriate locations and emptied regularly.

e. Working areas and work benches are clear and free of debris and other hazards.

f. Floors are clean and free from all obstructions, protruding outlets, foreign material, or slippery substances such as water, oil, and grease. Floor surfaces are slip-resistant.

g. Aisles, traffic areas, and exits are free of materials and other debris. They are properly marked and defined.

h. All corners are clean, well lighted, and free from waste materials.

i. Combustible materials are properly disposed of or stored in approved containers.

j. Clean rags and waste are stored in metal containers, while oily rags are stored in self-closing or spring-lid metal containers.

k. Extension cords do not cross aisles.

l. All flammable liquids are stored in safety cans and the safety cans are stored in fireproof rooms or cabinets.

m. Dangerous materials are stored in areas outside the main building.

n. All boxes, bins, shelves, cabinets, or containers used to store materials are properly marked or labeled.

o. Excess materials are not allowed to remain in the work areas.

p. Floors, walls, ceilings, ducts, electric lights, and windows are cleaned frequently and regularly.

q. Obsolete equipment is removed from the shop area and disposed of.

r. Sufficient brooms, brushes, cleaners, and other housekeeping equipment are readily available.

s. Pupil personnel organization systems are used to carry out specific housekeeping duties.

t. Personnel working in the area are instructed on the proper procedures to follow in keeping the area clean and orderly.

u. Regular and systematic inspections are made to maintain clean and orderly conditions.

v. Warning signs, symbols and similar labels are used to alert people to hazardous conditons, defective equipment, eye protection requirements and other hazards. These labels are placed in conspicuous locations and are kept clean.

w. Signs that inform students, teachers, administrators and visitors of the need to wear eye protection are conspicuously located at the entrance of each practical arts and vocational technical education classroom or laboratory.

Laboratory Arrangement

The layout or laboratory organization should not produce congestion or bottlenecks during the work period. Working in crowded quarters is hazardous.

1. Equipment Arrangement Considerations--There should be sufficient space to handle material with the least possible interference from or to any person or machine. The following considerations generally apply to vocational facilities:

a. A minimum of three feet of open space should surround each piece of equipment.

b. Major aisles should have a minimum width of four feet while secondary routes could be three feet. Note, when working with large items, e.g., in building trades, vocational agriculture, and the like, these dimensions would need to be increased significantly.

c. Equipment arrangement should provide for the safe and convenient flow of materials and personnel.

d. Equipment which is needed for successive operations should be located in close proximity.

e. Space for cleaning and maintenance should be allowed between machines, tools and work stations.

f. Equipment should be arranged by height in order to afford the instructor an unobstructed view of the facility.

g. Equipment requiring the most instructor supervision should be located closest to the central laboratory area.

h. The incidence of natural and supplementary light should be appropriate to each machine and/or work station's location. (Additional details are supplied in the Illumination section).

i. Safety zones painted/taped on the floor are often appropriate around machines/equipment.

2. Flooring/Working Surfaces--The surfaces on which students walk and work may include flooring, ramps, stairs, ladders, scaffolding, etc. Safety factors to consider in selecting walking and working surfaces involve load capacity, durability, drainage, dustiness, texture, heat conductivity, electrical conductivity, flammability, etc. Working surfaces should be properly maintained.

   Walking surfaces that protect against slipping and falling are another important consideration. Floors of classrooms and laboratories can be waxed to a point that endangers footing. Specialized non-slip pads, strips, or treatment is needed on floor surfaces around equipment/operations that engender spilled liquids and/or chips.

3. Fire Protection Code--Missouri does not have state regulations regarding fire protection. Therefore, each town or city has the responsibility of organizing and enforcing a fire protection code for its school facilities. Many communities use the National Fire Protection Association Code as a model for their local regulations. Refer to the NFPA's Volume 9, 101, Life Safety Code regarding "exit" regulations and related guidelines.

Exits and Exit Markings

1. Exits--Practical arts and vocational technical education instructors and facility designers/renovators are referred to specific National Institute of Occupational Safety and Health guidelines for exit considerations. In general these require:

   a. exit routes that lead to a public way.

   b. that areas around exit doors, and passageways leading to and from the exit, must be kept free of obstructions.

   c. that exit access must be arranged so that it is unnecessary to travel toward any area of high hazard potential in order to reach the nearest exit (unless the path of travel is effectively shielded by suitable partitions or other barriers).

   d. that a door from a room to an exit, or to a way of exit access, must be of the side-hinged, swinging type. It must swing out in the direction of travel if 50 or more persons occupy the room or if it is an exit from an area of high hazard potential.

   e. that no lock or fastening may be used which prevents escape from inside the building.

   f. that exits must be readily accessible at all times. Where exits are not immediately accessible from an open area, every occupant of that area must have access to two exits by separate paths. These paths must be through safe passageways, aisles, or corridors which lead directly to the exits.

2. Exit Markings--NIOSH guidelines include specific provisions that:

   a. every exit must be marked with the word "EXIT" in plain, legible letters not less than 6 inches high with the strokes of the letters not less than 3/4 inch wide.

   b. the visibility of the sign must not be impaired by decoration, furnishings, or other signs.

   c. doors, passageways, or stairways which are neither exits nor ways to an exit, but may be mistaken for an exit, must be clearly marked "NOT AN EXIT" or with a sign indicating their actual use, e.g., "STORAGE ROOM" or "TO BASEMENT."

   d. in areas where the direction to the nearest exit may not be apparent, an exit sign with a directional arrow must be used.

   e. exit signs must be illuminated by a reliable light source if occupancy is permitted at night, or if normal lighting levels are reduced at times during working hours (3, pp. 46, 47).

Storage Provisions

Perhaps one of the more frequently slighted safety provisions is that of adequate and appropriate storage facilities and methods. This is unfortunate because the safe storage of materials and tools is directly related to effective teaching and instruction, good housekeeping activities, fire protection procedures, and other elements of a safe school shop/laboratory environment (50, p. 106).

1. Reasons for Safe Storage Facilities--Careful organization helps:

   a. protect students and others working in the shop from accidents (explosions, fires, health, etc.).

   b. protect tools and materials from theft, unauthorized use, improper or unsafe handling, breakage and deterioration.

   c. the teacher to keep accurate inventories.

2. Storage Space--An additional area amounting to 10% of the laboratory or shop is generally considered adequate for storage of materials. Considerations for the location of storage space include safety and ease of storage, supply delivery and material issuance.

3. Storage Methods--All materials, tools, parts, and accessories should be stored safely and neatly and arranged in an orderly and accessible way in the places provided, regardless of the specific storage method. Those items used most frequently should be stored within easy reach on the lower shelves. Storage areas must be clean, dry, orderly, ventilated, and well lighted. Containers, bins, shelves, and drawers which contain caustics, acids, solvents, and bundles of materials should never be stored on the tops of lockers or cabinets, because there is always the danger of objects falling from these places. Generally, vertical storage of long pieces of material creates greater hazards than horizontal storage (8, p. 113).

4. Tool Storage--Many different methods and techniques have been devised for storing hand and portable tools. The most common tool storage methods are tool panels, centralized tool cribs, wall cabinets, bench drawers, and movable racks. Regardless of the methods selected, tool storage facilities should be designed and arranged to provide maximum protection from hazards (8, p. 113). The sharp edges of all tools should always be protected and placed so as to preclude possible contact when reaching for them.

5. Material Storage--Regardless of the system used, the storage facilities should be located for convenience and safety. Some schools use the closed storage method, in which all supplies and materials are kept locked in the storeroom or cabinets. Others use the open storage method, where persons are permitted

to use supplies as they are needed. A combination of the open and closed systems of materials storage is used most frequently. For safety reasons, some materials, particularly hazardous chemicals, should be in locked storage areas and used only under immediate supervision (8, p. 113).

6. Flammables--The storage of flammable liquids, such as gasoline, thinners, and other liquids, presents many problems from the standpoint of health, convenience, fire control and explosion prevention. The storage of such materials can be very troublesome and dangerous unless flammable liquid storage areas are carefully planned and provisions are made to safely care for the various types of flammable materials (8, pp. 113-114). Because of their flash point and low ignition temperatures, flammable liquids are dangerous and require the following precautions (6, pp. 12.30-33):

   a. When possible, avoid the use of highly flammable liquids by using in their place nontoxic and nonflammable (or less flammable) liquids.

   b. Keep flammable liquids in approved fire resistant safety containers (never in glass containers!). Keep all flammable liquids in closed containers when not in use.

   c. Limit the amount of flammable liquids in the open shop/laboratory area to that needed for one day.

   d. Provide safe operating procedures, including local exhaust systems, for all processes using flammables.

   e. Remove or control all ignition sources such as static electricity, smoking and open flames.

   f. Provide for adequate clearances between flammable liquid containers/safety cans and any heat sources.

   g. Anticipate flammable liquid spills and provide means to control and limit spillage, as well as suitable absorptive materials for use in cleaning up spills. Clean up promptly all spills of flammable or combustible liquids.

   h. Provide adequate ventilation for all operations involving the use or storage of flammable liquids.

   i. Make sure that all connections on all drums containing flammable and combustible liquids are tight.

   j. Always use and handle flammable liquids with extreme caution, no matter how familiar they are.

   k. Store large amounts of flammable liquids in a separate fire-resistant building or vault, which conforms to the recognized standards. Storage tanks should be properly vented and supported by masonry or, in diked areas, by concrete supports.

7. Compressed Gas Cylinders--The hazards of flammable gases are generally similar to those of flammable liquids, except that commercial gases are usually contained in compressed gas cylinders. Flammable compressed gases usually burn with a greater intensity than exposed flammable liquids. Acetylene, propane, hydrogen, natural gas and butane are examples of flammable gases. The following recommendations are generally appropriate to practical arts and vocational technical education (6, pp. 12.32-33):

   a. Contact regulatory agencies regarding current regulations and specific applications to special service areas/courses.

   b. Keep cylinders away from radiators, sources of heat and other combustible materials.

   c. Secure cylinders to prevent their falling over.

   d. Storage areas should be well ventilated.

   e. Keep protective valve caps on whenever possible.

   f. Additional ventilation is needed for bulk storage of compressed gas.

   g. Guard against impact, scratching, or arcing on cylinders.

   h. At least 20 feet of space or a fire barrier is required between stored oxygen and fuel gas tanks (34, p. 11.03).

Personal Service Facilities

Personal services facilities are an important aspect of emergency provisions as well as for general health and safety. Such facilities should be provided for the comfort as well as the safety of the individual. Because the requirements for each laboratory, shop, or classroom are determined by the type of work being done, potential hazard occurrences, number of students involved, and other similar factors, the environment of the workplace should be carefully assessed to ascertain the special needs and provisions required. These may include any or all of the following.

1. First Aid Stations/Kits--Each vocational laboratory should be equipped with adequate first aid supplies. It is recommended that instructors check with the school nurse or physician to determine the kit size and contents deemed adequate for the number of students and activities performed. The Red Cross also has useful suggestions. Kits may be purchased from safety supply companies or self developed.

   All contents should be organized for quick selection and inventory and restocking is very important. Supplies should be regularly checked and students should become familiar with emergency procedures and the kits should be kept in an accessible location.

2. Eye Wash Facilities--In areas where potential dangers to the eyes exist some means of flush or irrigation should be available. Clean water by means of any eye wash fountain, an emergency shower, hoses, a sink or tap, or other appropriate source will be helpful in case of emergency.

3. Deluge or Emergency Showers--Deluge showers should be installed and maintained in those vocational labs that have a high risk of chemical burns or possible fire. Sufficient water at a fast rate is necessary to provide rapid flushing or dousing of the individual. Both permanent and portable deluge showers are available.

4. Restrooms--Sanitary and separate facilities are recommended for male and female students. Wash basins within easy access of all shop/lab areas are desirable for emergency and personal cleanliness reasons, and both hot and cold water should be provided. Some guidelines suggest two feet of trough/20 students to be adequate (50 , p. 102). Sinks should be chemical-proof where appropriate. Soap needs to be available in an adequate dispenser (note that bar soap is considered unsanitary in public facilities). Finally, individual hand towels of cloth or paper, warm air blowers or clean individual sections of continuous cloth toweling convenient to laboratories, are required (43, 1910.141).

5. Drinking Water--Fresh drinking water should be conveniently available to all individuals, and the dispenser needs to be maintained for sanitation. If mechanically cooled, the recommended water temperature is between 45-60°F.

6. Lockers and Change Areas--A room for students to change and store work clothing should be provided in those vocational facilities where this is appropriate. Perforated lockers, large enough to allow clothing to be hung are desirable. With respect to the cleaning of clothing, vocational instructors need to be aware that compressed air shall not be used for cleaning purposes except when reduced to less than 30 p.s.i. and then only with effective chip guarding and personal protective equipment [43, p. 1910.242(b)]. Nor should it be used for the dusting of clothing because compressed air directed at the body may be fatal.

Fire Protection

A great potential exists for fires in practical arts and vocational technical education shops and labs. Therefore, instructors and administrators often find it useful to seek the help of local fire departments,

insurance carriers, state fire marshalls, and other experts in eliminating potential causes of fires and also in developing protective methods.

1. Control System. Three factors are necessary to cause fires: (1) oxygen, (2) fuel, and (3) a temperature high enough to cause ignition. To prevent or extinguish fire one or more of these factors must be controlled or eliminated. Fire control systems within an educational facility can include:

   a. Detection and alarm systems such as:

      - ionization -- detects combustion particles generated in the incipient state (created by chemical decomposition)
      - photoelectric -- smoke detectors
      - infrared -- detects when smoke level decreases and heat level increases
      - thermal -- detects heat (6, pp. 12.49-12.51)

   b. Automatic sprinkler systems. Types include:

      - wet-pipe -- sprinklers are attached to a piping system containing water
      - dry-pipe -- sprinklers are attached to the piping system containing air and nitrogen under pressure. Water then flows in as the dry-pipe valves open

   c. Specialized systems used where water may not be an acceptable extinguishing agent (for example a computer or electronics facility). Special systems include:

      - foam
      - dry chemical
      - carbon dioxide
      - water spray (containing a wetting agent)

   d. Portable fire extinguishers Portable fire extinguishers are the first line of defense. They are needed even when the vocational shop has other systems. The National

Safety Council lists six requirements for effective portable extinguishers (38, p. 1343). They must be:

- reliable, i.e., high quality.
- the right type for each class of fire that may occur in the area.
- provided in sufficient quantity to protect against exposure in the area.
- located where they are readily identifiable and accessible for immediate use.
- maintained in perfect operating condition, inspected frequently, checked against tampering and recharged as required.
- operable by the persons who are in the area, who can find them and who are trained to use them effectively and promptly.

2. Fire Type Classifications. New fire classification symbols have been adopted for ease and recognition. The old symbols, with the letters A, B, or C printed on their respective geometric shapes, were thought to be confusing. The old symbols may still be found on some extinguishers due to the invariable lag in changing from old to new.

   The new symbols consist of three panels, each of which depicts the nature of the fire and the type of extinguisher which can be used on them. The symbols are colored for quick recognition. Panels printed with blue show the class of fire for which it is safe to use a specific extinguisher. Those panels printed in black with a red diagonal slash, signify that the extinguisher is not designed for that class of fire. Instructors need to incorporate such information into their instruction because if the wrong extinguisher is used, it might spread the fire, cause an explosion, or perhaps even electrocute someone.

   a. CLASS A--fires include those involving paper, wood, rubber, cloth, namely the ordinary materials used in most offices and classrooms. Water extinguishers usually weigh over 20 pounds each and are effective against CLASS A fires. Multipurpose dry chemical (ammonium phosphate) extinguishers can also be utilized, however they leave a residue which must be cleaned up immediately to avoid affecting the sprayed material (10).

b. CLASS B -- fires involve flammable liquids and gases, grease, and oil. CLASS B extinguishers use dry chemical (sodium bicarbonate or Purple K-potassium bicarbonate), multipurpose, or foam materials. Extinguishers suitable for CLASS B fires usually will fight CLASS C fires, too. A Purple K extinguisher has the greatest initial fire-stopping power of any of the units with the B symbol; but as with multipurpose extinguishers--the residue must be cleaned up right after a fire is out, to avoid reaction with the sprayed materials. Automatic carbon dioxide extinguishers often are installed in kitchen hoods to battle grease fires as soon as they start. In a small closed area however, this carbon dioxide can displace the oxygen and asphyxiate people (10).

c. CLASS C -- fires are electrical in nature. The CLASS C extinguisher will fight fire in live electrical equipment but it is important to cut the current promptly because no extinguisher will permanently put out an electrical fire which is being constantly fed more current. Furthermore, by cutting off the current the fire will often burn out quickly by itself. The CLASS C symbol always will be found on multipurpose, dry chemical, and carbon dioxide extinguishers--never on water or foam extinguishers (10).

d. CLASS D -- fires occur with combustible metals. Specialized techniques, extinguishing agents and equipment are used to control fires of this type. Regular extinguishing agents should not be used on CLASS D fires in that there is a real danger of increasing the fire's intensity. Extinguishers suitable for controlling CLASS D fires are identified by a 5-pointed star with the letter "D" printed within (yellow if colored).

3. Recommended Actions In Case of Fire--Since it is necessary that all persons in the shop or laboratory know exactly what to do in case of fire, the general rules established by the principal should, of course be followed. In addition, students should be given instruction on the following (11, p. 18):

a. How and when to turn in a fire alarm (the first emergency step taken is to notify the Fire Department)

b. How to determine whether extinguishment should be attempted and subsequently how to extinguish fires. Normally students should not fight fires. This responsibility is the teacher's, and then only until all students are removed from the danger area.

c. What to do in the event of alarm, such as turning off machines, disconnecting power at main switch, turn off gas valves and torches, etc.

d. How to leave the building

4. Extinguisher Use Training--Instructors and students should be trained in the use of portable fire extinguishers. Besides knowing how to operate extinguishers and how to apply agents effectively, they should be familiar enough with the equipment to know when a fire is beyond the capabilities of portable extinguishers. Training in proper use includes (6, pp. 12.75-76):

   a. using a sweeping motion that extends at least six inches on each side of the near edge of the flames.

   b. maintaining a proper distance from the fire to avoid splashing fuel or burning material.

   c. holding most portable units upright.

   d. attacking flames at the fuel source.

   e. keeping the extinguisher's agent flowing so that the fire cannot reignite.

5. Fire Blankets--Instructors and students need to be aware of other extinguishing means in a fire emergency. A 100% wool fire blanket is a necessary item in many vocational education laboratories. It can be used to aid victims with burning clothing (by smothering flames). Typically, fire blankets are stored in a special, well-marked and accessible compartment within the laboratory. Note: Do not let a person with burning clothing run. Furthermore, since melted synthetic clothing material can cause serious skin damage if extinguished by rolling or using a blanket, water is thought to be the most effective method in extinguishing burning clothing. Work clothing (overalls, coveralls, aprons, etc.) worn in shops/laboratories with significant fire hazards should be 100% cotton fabric or otherwise fire resistant. Synthetic fabrics or partially synthetic fabrics are undesirable in such situations.

6. Evacuation--As part of fire protection instruction, a plan for the orderly evacuation of vocational facilities should be designed to include the following (6, p. 12.80):

   a. An evacuation signal

   b. A well planned evacuation route for all areas of the shop

   c. Designation of a student assembly area well away from the school

   d. An accounting procedure for all persons after assembly, keeping in mind those absent from the shop that day

   e. A search of the building to assure complete evacuation

Electrical Safety*

Most electrical tragedies can be prevented if the necessary precautions are taken to eliminate unsafe electrical conditions and practices. The vocational educator must assume that any electrical circuit is a potential hazard, regardless of the amount of voltage applied or current flowing through the wires to the equipment. Causes of electrical accidents can in most cases be traced to 1) defective equipment, 2) unsafe work practices, and 3) lack of knowledge of the dangers of electricity (50, p. 123). Therefore, vocational teachers must recognize the importance of, and the need for, the identification and elimination of hazards created by electricity. Failure to understand the dangers of electrical energy is a cause of many accidents. Electrical energy is not to be feared, but to be respected. All practical arts/vocational technical education teachers need to understand the relationships among amperage, voltage, and resistance.

1. Defective Equipment--Equipment involved in electrical accidents, include motor-driven equipment, control devices, portable electric tools, switches, panels, cutouts, conductors, plugs and fuses, and electric extension cords. Some of the common defects of tools and equipment are (50, p. 123):

   a. improperly grounded equipment (ground wires missing, broken, or improperly connected.

   b. open conduits, switch boxes, damaged or worn connections, and exposed live wires.

   c. insulation which is defective, inadequate, worn, frayed, wet, oily or deteriorated creating short circuit possibilities, and energizing equipment frames.

   d. defective switches, receptacles, extension cords, and lamp sockets.

   e. dirty motor windings, improperly adjusted brushes, and inadequate maintenance.

   f. improperly connected power tools and defective insulation in portable tools.

   g. loose vibrating machine parts.

* Much of the Electrical Safety section was adapted from William Williams, An Accident Prevention Program for School Shops and Laboratories, National Safety Council, Chicago, 1968 (50).

2. Unsafe Practices--These result in electrical accidents and fires. In shops/laboratories some typical practices include:

   a. using ungrounded equipment (except for double insulated portable hand tools).

   b. using defective tools or equipment in need of repair.

   c. using equipment which does not meet the approval of the Underwriters' Laboratories or other similar agencies.

   d. cleaning of electrical panels, switch boxes, motors, and other electrical equipment with water or dangerous solvents.

   e. overloading of circuits or overfusing circuits by the use of wrong size or type of fuse or electrical cord.

   f. failure to use explosion-proof or vapor-proof fixtures in dangerous areas such as paint booths, chemical storage, and paint storage rooms.

   g. failure to use suitable safety equipment, gloves, rubber mats, etc. for electrical installation and repair.

   h. failure to de-energize circuits before working on equipment.

   i. failure to mark, tag, or identify and lock switches properly prior to working on electrical equipment.

   j. installing electrical services in ways that do not meet the National Electrical Code.

   k. permitting rubbish, trash, rags, etc., to accumulate near electrical equipment.

   l. work practices which damage motors, insulation, wires, or electrical accessories.

   m. disconnecting of electric cords by pulling on the cords rather than on the plug.

   n. use of metal ladders while working on electrical equipment (50, pp. 123-124).

3. Lack of Knowledge--Ignorance causes many electrical accidents. It is unfortunate that a number of electrical accidents do happen because the person "just didn't know any better." This lack of understanding of electricity can be remedied by adequate supervision and a sound educational program (50, p. 124).

4. Prevention and Elimination of Electrical Hazards--Electrical hazards may be controlled by a program directed toward (1) preventing the development of hazards, and (2) eliminating present

hazards. In both cases a positive program of action must include education and training. Students should be taught the basic concepts necessary to understand electrical energy. Safe practices should be taught and the reasons for each practice explained to the students. Teachers must analyse the instructional facility's environment and list all possible sources of electrical hazards. Items on the list should be discussed with students and the safe practices which attend each hazard then need to be taught.

Even though the safest equipment is purchased the value of careful selection is lost if equipment is improperly installed. All wiring and installation should be done by qualified electricians who will perform the work in accordance with the local and state requirements, as well as meeting the specifications of the National Electrical Code. Haphazard electrical work and temporary hook-ups must not be permitted in the school shop. All original and subsequent electrical installations should be made so that:

a. all equipment is properly grounded.

b. wiring is of adequate size to carry the intended load.

c. each item of equipment is individually protected with fuses or circuit breakers.

d. wiring is protected from damage.

e. sub-master switches are installed (emergency shutoffs).

f. magnetic starting switches, preferably low voltage, are incorporated on each piece of equipment to prevent inadvertent restarting.

In shops where two or more voltages are used for different kinds of portable equipment, special receptacles are needed for each voltage. Receptacles and the corresponding cord plugs must be designed to eliminate all possibility of connecting the equipment to the wrong source of power (50, pp. 124-126).

5. Grounding--Laboratories designed and constructed before the importance of grounding was recognized may have outlets that lack an opening for the ground lug found on most portable power tools. If an adaptor is used to accomodate grounded tools, the ground wire or ground lug must be connected to the screw that fastens the cover plate to the electrical box. If neglected the safety grounding feature becomes useless. Then, should some internal wiring become defective and short to the frame, the unit becomes "electrically alive" and certainly dangerous.

6. Ground Fault Circuit Interrupters--Safety devices known as Ground Fault Circuit Interrupters (GFI's) have the potential of saving numerous lives. The GFI continually monitors electric circuits and immediately cuts off power if a current to ground

is detected. This means that, if an appliance or piece of equipment has a faulty ground, then the GFI will cut power so that the individual(s) using the equipment will not be electrocuted. GFIs are recommended in kitchens as well as other vocational laboratories/shops. An electrician should be consulted for proper installation.

7. Circuit Testing--As an initial check for possible wiring problems in practical arts and vocational technical education classrooms and laboratories, a device that inserts directly into the outlet can be used. This inexpensive device tests for reversed polarity, faulty ground, and existence of voltage. Should incorrect readings occur, instructors should inform, in writing, the institution's maintenance supervisor and supervisor/principal to alert them to the problems.

8. Polarity of Outlets and Tool Connectors--Insure that all three phase male connectors and receptacles are polarized so that tools always run in the same direction regardless of outlet used. This prevents unexpected reversing and possible loosening of wheels, discs, or saws.

9. Summary--An adequate program for the prevention and elimination of electrical hazards must rest upon (1) intelligent selection and purchase of equipment, (2) correct installation of equipment, (3) education of students in the safe use of electrical energy, (4) periodic inspection of equipment, and (5) regular maintenance (50, p. 126).

ENVIRONMENTAL FACTORS

Lighting/Illumination

Good lighting is an essential to safe laboratory conditions. Unless lighting is appropriate, needless accidents will occur. Both the quality and the quantity of light are important safety factors. A selection of key concerns is presented in the following pages, but because of the field's complexity, materials from the Illuminating Engineering Society are recommended for detailed data.

1. Light Quantity--The amount of light that produces sufficient brightness to illuminate the work area. This amount is measured in foot candles and is measured with a calibrated light meter. TableII provides some recommendations for sample tasks (6, p. 11.5).

2. Light Quality--The distribution of brightness in the visual environment. Glare, diffusion, direction, uniformity, color brightness, and brightness ratios all have a significant effect on visibility and the ability to see easily, accurately and quickly (6, p. 11.9).

3. Brightness Ratio--The ability to see detail depends upon the difference in brightness between the detail and its background. Eyes function most comfortably and efficiently when the difference is kept within a certain range, as shown in Table III (6, pp. 11.9-11.10).

4. Lighting Problem Indicators--Often subtle factors suggest the presence of lighting inadequacies. The survey form provided in Figure 8 is useful for identifying such problems, but instructors also need to be alert for signs such as:

   a. direct or reflected glare.

   b. dark shadows.

   c. excessive visual fatigue.

   d. delayed eye adaptation when shifting eyes from light to dark areas.

5. Types of Lighting--A variety of types exist. These include:

   a. local lighting produced for a given area.

      - adjustable lamps illuminating the point of operation
      - portable lamps provide temporary illumination for projects requiring supplemental lighting
      - specialized lamps for fine precision work (50, p. 10)

   b. general lighting for even distribution throughout the shop, lab, classroom, etc.

   c. explosion proof.

TABLE II

Levels of Illumination Recommended For Sample Occupational Tasks*

Area	Foot-candles	Area	Foot-candles
Assembly-rough, easy seeing	30	Materials-loading, trucking	20
Assembly-medium	100	Offices-general areas	100
Building construction-general	10	Drafting rooms-detailed	200
Electrical equipment, testing	100	Corridors	20
Elevators	20	Paint dipping, spraying	50
Garages-repair areas	100	Service spaces-wash rooms, etc.	30
Garages-traffic areas	20	Sheet metal-presses, shears	50
Inspection, ordinary	50	Storage rooms-inactive	5
Inspection, highly difficult	200	Storage rooms-active, medium	20
Loading platforms	20	Welding-general	50
Machine shops-medium work	100	Woodworking-rough sawing	30

*Figures from A132.1-1973, Office Lighting, published by the Illuminating Engineering Society. Others from ANSI, AIIJ. (14)

TABLE III

Maximum Brightness Ratios*

	Environmental Classification		
	A	B	C
Between tasks and adjacent darker surroundings	3 to 1	3 to 1	5 to 1
Between tasks and adjacent lighter surroundings	1 to 3	1 to 3	1 to 5
Between tasks and more remote darker surfaces	10 to 1	20 to 1	-
Between tasks and more remote lighter surfaces	1 to 10	1 to 20	-
Between luminaires (or windows, skylights, etc.) and surfaces adjacent to them	20 to 1	-	-
Anywhere within normal field of view	40 to 1	-	-

- Brightness Ratio control not practical.

A-Interior Areas where reflectances of entire space can be controlled in line with recommendations for optimum seeing conditions.

B-Areas where reflectances of immediate work area can be controlled, but control of remote surroundings is limited.

C-Areas (indoor and outdoor) where it is completely impractical to control reflectances and difficult to alter environmental conditions.

Note: From the normal viewpoint, brightness ratios of areas of appreciable size should not exceed those in the above table.

*From American National Standard A11.1-1973, Practice for Industrial Lighting, Illuminating Engineering Society (14).

Figure 8

Illumination Survey Form

Production, safety, and personal comfort demand good lighting. Use this survey form to check on the general efficiency of the present lighting system. A "No" answer to any of the questions listed below will indicate a need for a more detailed inspection and, possibly, the services of a competent illumination engineer.

QUESTION	LOCATION	YES OR NO	REMARKS
1. Are proper levels of light maintained in different areas and for different operations? (Direct light meter readings should be taken and checked against established level for a particular area of operation.)			
2. Are "task zones" adequately illuminated? (harsh shadows and reflections eliminated)			
3. Are lights mounted properly so that employee will not have to perform work in his own shadow?			
4. Are all lights properly shielded, louvered, or mounted to prevent direct glare?			
5. Is there efficient control of indirect glare from work surfaces, machine control dials and knobs, and from the piece on which work is being performed?			
6. Is general lighting uniform outside "task zones"?			
7. Have "high contrast" areas been eliminated or "toned down" through use of color and balanced lighting?			
8. Are special lamps and fixtures provided where unusual conditions prevail? (vibration resisting, weather resistant, explosion resistant, etc.)			
9. Are lighting fixtures receiving proper maintenance? (periodic cleaning, replacement, etc.)			
10. Are windows and skylights cleaned regularly?			
11. Is an adequate emergency lighting system maintained for use in the event of power failure?			
12. Are lights protected against impact where appropriate?			

Additional remarks: _____

Date _____ Signed _____ Department _____

Accident Prevention Manual for Industrial Operation, (26, p. 95)

6. Stroboscopic Effects of Fluorescent Light--Due to the construction of the fluorescent lamp, their light tends to flux at 60 cycles per second (Hertz). Since this occurs so rapidly, one cannot easily observe this effect. However when fluorescent lighting is used to illuminate moving or rotating objects, under some conditions it can generate a stroboscopic effect that appears to freeze motion. By making moving objects seem to stand still, dangerous false impressions can result.

   For this reason, fluorescent lighting should not be the sole light illuminating, nor should its circuitry be used to power equipment such as lathes, printing presses, centrifuges, saws, and the like. A recommended procedure is to supplement fluorescent lighting with localized "on the machine" incandescent lighting. Alternatively, multiple tube fluorescent fixtures can be wired to connect individual banks to different phases of current.

7. Lighting Maintenance--It is advisable that all reflectors, lamps, and lighting devices be kept clean, properly adjusted and maintained in good state of repair.

Color Coding

The following material is at present a proposal* only. It is however, the latest information available regarding a safety color code.

This safety color engineering practice agrees or is in accordance with both the Occupational Safety and Health Act (OSHA) and the American National Standards Institute (ANSI). The code was approved and adopted by the safety committee of the American Vocational Asociation.

1. Color Code Purpose and Scope--The intent of this engineering practice is to establish a safety color code in training and educational shops, to alert and inform persons to take precautionary action in the presence of potential hazards.

   The primary purpose of a safety color code is to promote safety and reduce the number of accidents. The use of color is not a substitute for engineering and administrative controls.

2. General Principles--The color safety treatment includes painting the equipment, safety signs, walls, ceiling, and lanes on the floor of the practical arts and vocational technical education laboratory where desirable.

   - Color contrast shall be made between the object that is color coded and/or the safety sign and its background.

   - Bright colors should not be placed in the line of vision of the operator because they are disturbing to the operator, causing the operator to change the focus of vision from one object to another, resulting in fatigue.

*Used with the permission of the American Association for Vocational Instructional Materials.

- The colors of the walls, ceilings, floor cabinets and base equipment should be coordinated.

- Color coding should distinguish the dangerous from the less dangerous part of machines. The operator must focus on the work being done; and at the same time, must readily observe the moving parts, adjusting levers and controls of the machine.

- Discretion must be used when deciding whether a total surface should be painted or the outline of the surface be painted. Frequently, too much paint will defeat the purpose of color coding.

3. Safety Colors For Shop Equipment and Typical Uses

   a. Safety Red represents danger. It shall identify areas or items of danger and emergency. The following applications are examples of Safety Red:

      - Danger signs. The word DANGER is written in white letters on a red background.

      - Emergency stop bars on hazardous machines, stop buttons or electrical switches used for emergency stopping of machinery.

      - Fire equipment and apparatus. If it is not practical to paint the fire equipment and apparatus, then the background should be painted in Safety Red.

      - Containers of flammable or combustible materials having a flash point at or below 27°C (80°F). Identify further by a yellow band at least 1/4 of the height of the container, or with yellow labeling.

   b. Safety Orange represents a warning. It shall designate machine hazards. The following applications are examples of Safety Orange:

      - Guards covering a specific hazard that must be in place before operation is begun.

      - The electrical box containing the stop button level or toggle of an electrical switch.

      - Parts of a machine which might cut, crush, shock or otherwise injure a worker.

      - Hazards exposed when guards or shields for pulleys, gears, chains, etc., are removed or inspection doors are open (such as the inside of doors of fuse boxes and switch boxes).

c. Safety Yellow represents caution. Solid yellow, or diagonal yellow and black stripes, can be used in accordance with the color contrast between the safety sign, color-coded object and its background. The following applications are examples of Safety Yellow:

- Critical parts of machines, adjusting wheels, levers and knobs or any part that may need adjustment before or during the use of the machine.
- Mark with diagonal black and yellow stripes non-moving hazards that may cause stumbling, falling, or strike against low beams or machinery which projects into traffic lanes; or moving hazardous parts which extend beyond the machine when operated.
- Lettering, such as "Flammable, Keep Fire Away," on storage cabinets containing flammable materials shall be conspicuous with a high visibility contrast.
- Containers for explosives, corrosives, or unstable materials shall be yellow or be identified by a yellow band at least 1/4 of its height. The contents of the container shall be identified thereon.
- Caution signs.

d. Safety Blue represents informational signs if warning or caution is implied. The following applications are examples of Safety Blue:

- Indicates caution against using defective equipment or machines under repair or out of order. Large signs painted blue, with white letters and the words, "Out of Order," "Do Not Operate," or "Do Not Move," should be hung on a machine to warn potential users of unsafe conditions.

e. Safety Green represents safety and designates the location of first aid equipment. The following applications are examples of Safety Green:

- Shows the location of medical first aid kits, gas masks, stretchers, safety deluge showers, safety bulletin boards. On first aid kits, it is used either with a white cross on a green background or vice versa.

f. Safety Black, Safety White, or Combination of Safety Black with Safety White shall be for designating traffic and housekeeping markings. The following applications are examples:

- Identify barricades

- Combination of Safety Black and Safety White paint bands (not entire object) to identify movable objects, such as trash containers, etc.

g. Ivory although not a safety color, is used as a spotlight color to improve visibility. The following applications are examples of Ivory:

- For a background for viewing work being done
- Outlines the vertical edges of tables, other work surfaces or as a background for instruments

4. Miscellaneous Applications of Color

a. Safety Purple/Magenta is used to designate radiation hazards. Examples of the application of radiation hazard symbols colors are as follows:

- Rooms and areas where radioactive materials are stored or handled, or which have been contaminated with radioactive materials. Used in combination with Safety Yellow for markers such as tags, labels, signs and floor markers.

b. Safety Non-Glare Gray, Safety White or Safety Yellow may be used for floor lanes or work areas around machines if machines are stationary.

c. Safety Non-Glare Traffic Gray may be used for metal workbench tops and workbench tops with a natural finish wood to provide a restful color contrast. (An ivory band around the vertical edge of all tables makes the edges much more visible). It is not intended that all table tops be painted completely; this is the user's discretion.

d. Aluminum although not a safety color, may be used to paint waste containers. Note, for containers for oily rags and other flammable materials, paint a black band about 1/5 the height of the container around the top to indicate contents. Use an orange band about 1/5 the height of the container around the top of waste containers for oily rags or other flammable materials. Label the band to identify the material.

5. Electrical Receptacles-- See National Electrical Code

6. Luminescent Pigments and Reflective Tape--Luminescent pigments are useful to mark danger spots which are not visible at night, or location of signs and switches. The following are examples of the application of luminescent pigments and reflective tape:

- Stripes on stair railing and risers to make them visible at night

- Signs or directional arrows for fire escape or exit signs which are not lighted or readily seen when lights are out

- Switch plates of the luminescent type so that they may be readily located at night

7. Piping Systems*

The following are examples of the application of color coding for piping (all should have labels at point of use to identify materials carried by the pipe such as compressed air, natural gas). It is not necessary to paint pipe footage; however, all pipes should be identified. For example, at room entrances and exits, color bands may be painted around the pipe with intermediate bands 1" wide every 10' (2.5 cm wide every 3 m). If painted, use the same color as the background walls or ceiling. Do not paint rubber and flexible synthetic hoses or pipes. Identify pipes and hoses with decals or stencils or optional bands, and with the following color combinations:

- Safety Red with Safety Black lettering -- Fuel gas pipes, such as gasoline, acetylene, etc.

- Safety Green with Safety Black lettering -- Liquid gas pipes, such as oxygen and inert liquids

- Safety Yellow with Safety Red lettering -- Natural gas, steam at 100°C (212°F) or higher, and other hazardous and flammable materials and high-pressure fluids

- Safety Blue with Safety White lettering -- Compressed air (inert gases at low pressure)

- Safety Black bands -- Vent lines

- Safety Gray bands -- Service water and sprinkler pipes

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*Although both agencies have approved these AAVIM guidelines, there is yet a slight difference of opinions between members of OSHA and ANSI as to the usage of some of the colors for identifying piping. This is because of accidents to color-blind people who were not able to correctly identify the contents of the piping. Therefore, changes may be forthcoming, but both groups agree that all piping should be appropriately identified by signs and tags.

There are also questions being raised as to whether both danger areas and fire equipment should be safety red and steps are being taken to resolve this.

Ventilation, Heating and Cooling

Ventilation refers to the simultaneous supply and exhausting of air from the laboratory. There is a definite relationship between proper ventilation, comfort level and the frequency of accidents (48, p.6.02). With proper ventilation and adequate heating the student's work efficiency increases.

1. Air Supply Systems--When properly designed, installed and operated, air-supply systems:

   a. replace the air that is exhausted, thereby increasing the efficiency of the exhaust system.

   b. dilute air-borne dust, fumes, and undesirable heat sufficiently so that exhaust volumes can be reduced.

   c. provide pressurization to prevent cross-contamination between areas.

   d. serve as a vehicle to allow heating, humidification, and air-cleansing.

   e. reduce or eliminate objectionable drafts.

   f. provide air motion over people to lower the effective temperature (26, p1007).

2. Air Exhaust Systems--The method of exhausting air can be general or local. The former involves venting of air from a building by natural or mechanically assisted flow through openings that may be situated in the roof or high on side walls without reference to specific laboratory operations (26, p1009). For a general exhaust system to be effective, a large supply of fresh air is needed. As a rule, such systems have low efficiency in controlling air-borne contaminants and hence they should not be used where there are major localized sources of contamination, especially highly toxic dusts and fumes (6, p13.106). For these, local exhaust is more effective in such cases.

   Furthermore, local exhaust systems are more effective and economical in air control procedure than are general exhaust systems. They provide a cleaner and healthier work environment even though handling a relatively small amount of air. Local exhaust systems usually consist of hoods, ductwork, air-moving devices (fan/motor). and often an air-cleaning device (26, p1010). Typically these components are situated as close as possible to the contamination source (i.e., workbench, area) and desirably they enclose a specific operation. Examples: fixed enclosures (booth), freely movable hoods, and down-draft benches (6, pp13.110-13.111). These devices dilute and remove unpleasant and dangerous contaminants from the breathing zone and/or laboratory atmosphere. Contaminants might include: dusts, mists, vapors, odors, and smoke.

3. Ventilation Considerations

   a. Location of exhausts:

      - Exhaust openings should be located as close as possible to the source producing the contaminant.

      - Unless the exhausted air is discharged far away from the fresh-air intake duct, the fresh air can easily become contaminated (6, p. 13.107).

   b. Air flow--To keep contaminants out of the student breathing zone, fresh air applied to the work space should first pass through the students' breathing zone, and only then across the work space where the contaminant is produced. From there it should be drawn into the exhaust system as rapidly as possible (6, p. 13.107). See Figure 9 for examples of both poor and preferred ventilation designs.

   c. Electrostatic precipitators/cleaners are useful devices but gases and noxious fumes remain a danger. Therefore, when these devices are the primary venting system, they must be installed to draw in clean make-up air.

4. Heating and Cooling Systems--These need to be capable of:

   a. supplying and removing heat to balance body conditions.

   b. preventing rapid temperature fluctuation.

   c. diffusing heat and cold without excessive drafts.

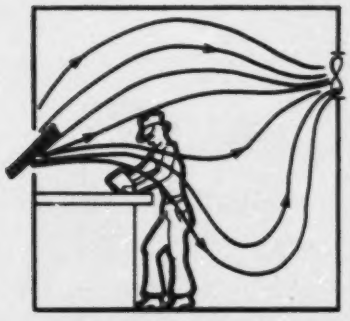
   d. creating a comfortable working atmosphere.

   e. being independently controlled and appropriate for the areas considered, e.g., classrooms, laboratory, and greenhouse.

   In addition, filters need to be cleaned and changed regularly, and all ventilation systems should be checked at the beginning of each school year by qualified personnel in order to confirm continued effectiveness (28, p. 1-3).

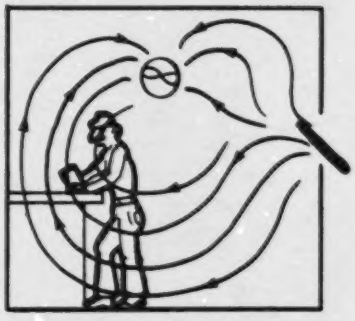
Figure 9

GENERAL VENTILATION



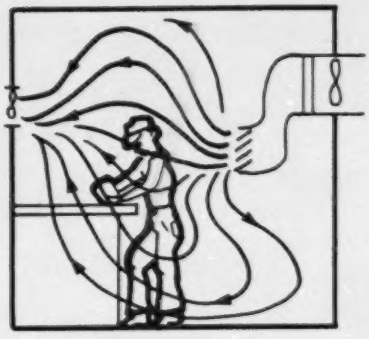
Poor General Ventilation

(Contaminant is driven into the worker's breathing zone and atmosphere)



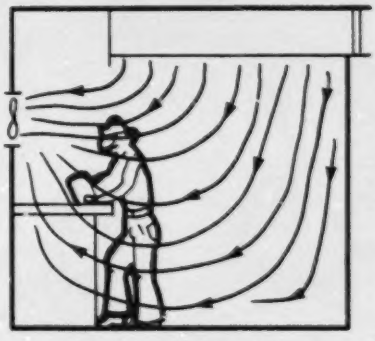
Fair General Ventilation

(Incomplete flushing of the room, contamination of general atmosphere)



Good General Ventilation

(Air enters at breathing zone height and keep contamination away from worker)



Best General Ventilation

(Low velocity diffusion through ceiling, immediate exhaust of contaminated air)

Reprinted from Safety and Health in Arc Welding and Gas Welding and Cutting (Cincinnati: NIOSH, 1978), pp. 29-30. (25)

Noise

The ability to hear is a precious gift. Without it, it is difficult to lead a fully productive life either on or off the job. Noise can destroy hearing, create physical and psychological stress, and thereby contribute to accidents in addition to the obvious cause by making it impossible to hear warning signals (44, p. 2). Practical arts and vocational technical education laboratories and shops are not exempt from noise pollution considerations--particularly if maximization of learning and safety are the goal!

Noise is an unwanted sound. It is a form of energy or vibration that is conducted through the atmosphere. There are four variables that can affect the intensity of noise and its potential danger.

- The level of the sound, as measured in decibels (dB)
- The length of time to which one is exposed to the sound
- The numbers and lengths of quiet (recovery) periods between periods of sound
- Individual sensitivity to or tolerance for sound (6, pp. 13-25)

Table IV indicates that workers should not be exposed to a sound level which exceeds 90 dB on the average for an eight-hour day. It should be noted that the standards in this table apply only to work, i.e., day-to-day environments, and schools are typically different. In some cases, however, vocational courses approximate the work situation and hence, these standards might well apply. Furthermore, it also deserves noting that instructor exposure is often the equivalent of industry despite the fact that student exposure is not. Since hearing is affected by the totality of the noise that one is exposed to, any precautions are appropriate (6, p. 13.28).

Fortunately, noise exposure can be controlled. No matter what noise problems occur in the laboratory and workplace, the technology exists to reduce the hazard. The responsibility to correct noise problems rests on the individuals, i.e., supervisors, teachers, foremen, etc., involved. In general, there are three basic ways to control noise (44):

- At its source
- Along its path
- At the point of hearing through the use of protective equipment

TABLE IV

ALLOWABLE EXPOSURES TO NOISE

Total Exposure Time (hours/day)	Sounds Level (decibels)
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4	115

(Reprinted from General Industry OSHA Safety and Health Standards, CFR 1910.95, U.S. Dept. of Labor, November, 1978) 43

1. Source Control--The best and most effective approach to control noise is to control it at its source since in this way, no further hearing danger is posed and therefore, other control methods are probably not needed. Techniques of noise source control include:

   a. Reduction of impact noise

   b. Reduction of the speed of moving and rotating parts

   c. Reduction of pressures and flow velocities in circulating systems

   d. Reduction of flow resistance in circulation systems

   e. Balancing of rotating parts

   f. Reduction of friction in rotating, sliding, and moving parts

   g. Isolation of vibration within equipment

   h. Reduction of the size of the surface radiation areas

   i. Application of vibration-damping materials to vibrating parts and surfaces (6, p13.33-13.34)

2. Path Control--If source control is not possible, the next best approach is to control the noise along its path. Although such controls limit the number of persons exposed to the noise, they do not always eliminate the noise problem for all persons affected. In path control, noise is blocked or reduced before it is heard. This can be accomplished by:

   a. containing or enclosing the noise.

   b. absorbing the noise along its path.

   c. deflecting the noise away from our ears.

   d. separating the noise from the hearer (6, p13.34-13.35).

3. Hearer Protection--Finally, ear protection equipment is available. This is not as desirable as either source or path control because it affords protection only to those wearing the equipment. Students must be willing to wear hearing protectors whenever they are exposed to potentially dangerous noise. Certain conditions and activities can reduce the effectiveness of the hearing protectors themselves (6, p.13.32).

MACHINERY GUARDING

Introduction

Although responsible educators take considerable pains to purchase safe equipment, to teach safe procedures and otherwise minimize risk, machine guarding is, nevertheless, of the utmost importance in protecting students from the hazards associated with vocational operations. People cannot always be relied upon to act safely around machinery. Furthermore, from time to time people react differently to the same environment because of physical, mental, or emotional changes--sometimes reacting safely, sometimes not. It follows that even the well coordinated and highly trained person at times performs unsafe acts which could lead to injury. Proper guarding will allow the worker to work safely and minimize this risk (8, p. 114).

Types of Hazards

Essentially both mechanical and non-mechanical hazards need to be guarded against. The former involves machine and tool parts, and also the consequences of an act, while the latter pertains to all other sources of danger.

1. Mechanical hazards -- These derive from motions and actions of equipment and operators. The following are representative of these:

   a. Motions

      - rotating (mixers, blender, pulleys, etc.)
      - reciprocating, back-and-forth or up-and-down motion (punches, saws, etc.)
      - transverse, movement in a straight, continuous line (conveyors, carts, etc.)

   b. Actions

      - cutting: involves rotating, reciprocating and transverse motion; danger exists at the point of operation and in flying debris (bandsaws, circular saw, lathe, knives, etc.)
      - punching: danger occurs at the point of operation where stock is inserted and where the punch penetrates
      - shearing: involves applying power to a slide or knife in order to trim or shear material. Danger exists at the point of operation.
      - bending: results when power is applied to a slide in order to draw or stamp metal or other materials. Hazards occur at the point of operation. (Adapted from OSHA, 39, pp. 2-6)

c. Location of mechanical hazards

- point of operation: that point where work is performed on the material, e.g., cutting, shaping, boring, or forming of stock
- power transmission: all components of the mechanical system which transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears
- other moving parts: all parts of the machine which move while the machine is working (39 , p. 1)

2. Non-Mechanical Hazards -- These are hazards other than those caused directly by mechanical motion and moving parts:

a. Electricity: All power sources for machinery are potential sources of danger. When using electrically powered or controlled machines the equipment as well as the electrical system itself must be properly grounded. Replacing frayed, exposed, or old wiring will also help to protect the operator and others from electric shocks or electrocution.

b. High pressure, air, gas, or fluid systems: These systems need careful inspection and maintenance to prevent possible failure from pulsation, vibration, or leaks. Such a failure could cause explosions and/or flying debris (39 , p. 8).

c. Noise: Machines often produce noise that results in a number of hazards to workers. It not only can startle or disrupt concentration, but also interfere with communications.

d. Vibrations: This often causes misadjustment and/or loosening of critical components as well as noise. Injury, fatigue, and illness for the worker may be avoided if machines are properly aligned, supported, and anchored (39 , p. 9).

e. Harmful substances: Instructors, maintenance workers, and students in the work area need protection from potentially harmful substances. Since some substances cause ailments, safeguards of the appropriate type should be used. Specially constructed safeguards, ventilation, and protective equipment and clothing are possible temporary solutions to the problem of machine-related chemical hazards until these hazards can be better controlled or eliminated (39, p. 9).

Effective Guarding

According to OSHA, machine guarding involves "any means of effectively preventing personnel from coming in contact with the moving parts of machinery or equipment which could cause physical harm to the personnel" (26, p. 795). Effective guarding protects against injury resulting from:

1. direct contact with moving parts of a machine.
2. work in process; i.e. kickbacks, flying chips, splashing chemicals, tipping files, etc.
3. machine/work failure, fracture, etc.
4. electrical failure, interruption, short circuit, etc.
5. human failure, resulting from carelessness, ignorance, curiosity, zeal, distraction, fatigue, indolence, worry, anger, illness, deliberate chance taking, etc. (50, p. 108)

Of course, because of their comprehensiveness, the listed points are difficult to comply with, but the attempt must be made. Any machine part, function, or process which may cause injury must be safeguarded. It will be easier to comply with this requirement if guards are considered as part of the machine at the time of purchase.

Methods of Guarding

There are many ways to safeguard equipment/machinery. The type of operation, the size or shape of stock, the method of handling, the physical layout of the work area, the type of material, and instruction and production requirements or limitations will help determine the appropriate safeguarding method for the individual machine. Protection may involve any or all of the following:

1. Guards
2. Devices
3. Location/distance
4. Feeding and ejection methods
5. Miscellaneous aids (39, pp. 11-12)

Requirements for Guards

In general, guards should be designed and installed in accordance with key safety principles. This means that the guards should:

1. Prevent Contact--Eliminating the possibility of the operator or another worker placing their hands, arms, etc. near hazardous moving parts.
2. Secure--Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must be firmly secured to the machine.

3. Protect from Falling Objects -- Safeguard should ensure that no objects can fall into moving parts.

4. Create No New Hazards -- A safeguard defeats its own purpose if it creates a hazard of its own such as not being securely fastened, out of adjustment, having jagged edges, etc.

5. Create No Interference -- Any safeguard which impedes a worker from performing the job quickly and comfortably might soon be overridden or disregarded.

6. Allow Safe Lubrication -- If possible, one should be able to lubricate the machine without removing the safeguards (adapted from 39, pp. 7-8).

OSHA has established requirements in relation to guarding and guard design, construction, application, and adjustment of the point of operation guards. Every guard must:

1. prevent entry into the point of operation by hands or fingers reaching through, over, or around the guard.

2. conform to the maximum permissible openings.

3. create no pinch point between the guard and moving machine parts.

4. minimize the possibility of misuse or removal of essential parts by utilizing fasteners which operators cannot remove readily.

5. facilitate inspection.

6. offer maximum visibility of the point of operation (6, pp. 15.13-15.14).

To summarize, guarding is a very complex task that requires much study, attention, and effort. Instructors are advised to develop a long-term and staged plan for the incorporation of all guards appropriate to their facility. Furthermore it is recommended that instructors seek the assistance of experts (e.g., equipment manufacturers, loss control specialists, safety agency consultants, etc.) to secure and install guards that:

1. protect the operator.

2. protect others in the area.

3. are a permanent part of the machine.

4. are convenient.

5. prevent access to the danger zone.

6. allow access to servicing.

7. are durable.

8. are easy to repair.

9. do not create a hazard.

10. conform to appropriate standards (6, pp. 15.24-15.26).

Construction of Guards

Guards designed and installed by the manufacturer offer two main advantages: (1) they usually conform to the design and function of the machine (2) they can be designed to strengthen the machine in some way or to serve some additional functional purposes. However, not all machines in use have built-in safeguards provided by the manufacturer.

User-built guards are sometimes necessary for a variety of reasons. They have these advantages:

1. Often, with older machinery, they are the only practical solution to continued use of the equipment.

2. They may be the only choice for mechanical power transmission apparatus in older plants where machinery is not powered by individual motor drive.

3. They permit desirable options for point-of-operation safeguards when skilled personnel and machinery are available to make them.

4. They can be designed and built to fit unique situations.

5. The design and installation of machine safeguards can help promote safety consciousness (39, p. 57).

User-built guards do also have disadvantages that need to be minimized or eliminated:

1. They may not conform well to the configuration and function of the machine.

2. There is a risk that user-built guards may be inadequately designed or built (39, p. 57).

Generally it is recommended that user-built guards be a last resort and then only for reasons of a lack of availability of commercial guards. Obviously a lack of funds would not seem an adequate reason should an incident result in legal action. It is recommended that when instructors do design and install guards and protective devices that they do so only with the specific approval of a knowledgeable supervisor. Incorporation of such plans in the annual documentation of the safety program is a convenient way to achieve this.

Training

Even the most elaborate safeguarding system cannot offer effective protection unless the operators know how to use it and why. Specific detailed training is therefore a crucial part of any effort to provide safeguarding against hazards. Training is necessary for new operators, when any new or altered safeguards are put in service, or when students are assigned to a new machine or operation. Thorough training involves instruction and/or hands-on training in the following:

1. A description and identification of the hazards associated with particular machines
2. The safeguards themselves, how they provide protection, and hazards for which they are intended
3. How to use safeguards and the reasons for them
4. How, under what circumstances, and by whom safeguards can be removed (in most cases, instructional or maintenance personnel only)
5. What to do (e.g., contact the instructor) if a safeguard is damaged, missing, or unable to provide adequate protection (39, p. 9)

Summary

The employee should be as aware as the employer, and the student as aware as the instructor, of the necessity for adequate machine guarding and the safe operation of machinery, if for no other reason tha one's health and future is at stake. Instructors are responsible for the regular inspection and recording of the condition of protection devices. Safe operating conditions depend on the detection of existing and potential hazards and on taking immediate action to remedy them.

SAFETY IN MATERIAL HANDLING

Because many practical arts and vocational technical education courses involve lifting and handling of machines and materials, it is important that students and instructor follow procedures that protect their bodies from injury. The Indiana Safety Guide for Health Occupations Programs recommends the following practices (13):

1. Stooping
   a. Stand close to object.
   b. Place feet shoulder-width apart with one foot in front of the other for firm footing.
   c. Bend hips and knees, lower the body, keep back straight and bring hands down to the object.

2. Carrying

   a. Keep back straight as possible.

   b. Keep weight load close to the body and centered over hips.

   c. Counterbalance the load by shifting part of the body in the opposite direction from the load to keep it in balance.

   d. Put the load down by bending the hips and knees, keeping back straight and the load close to the body.

   e. If the load is too heavy--GET HELP.

   f. If two or more people are going to carry the load, have one person assigned as the leader so he/she can give the commands.

3. Lifting

   a. Check to see if you can easily pull the load toward the body; if you can't, it is too heavy, so GET HELP.

   b. Grasp the load firmly and close to the center.

   c. Get ready to lift.

   d. Lift by pushing upward with the legs. Straighten back to an upright position.

   e. Keep the load close to you while lifting.

   f. Do not twist the body.

   g. To change direction while lifting, shift feet in the direction you want to go.

4. Pushing

   a. Stand close to the object to be moved.

   b. Crouch down ~~with~~ feet apart.

   c. Bend elbows and put hands on the load at chest level.

   d. Lean forward with chest or shoulder against the object. DO NOT push with arms or shoulders.

   e. Keep back straight. Crouch and push with your legs.

5. Pulling

   a. Place feet apart, one foot in back of the other, keeping close to the object to be moved. Allow room so that the forward foot will not be injured.

   b. Grasp object firmly, close to its center of gravity.

   c. Crouch, lean away from the object.

   d. Pull by straightening legs. Keep back straight.

   e. Walk backward with crouching strides, so the legs do all the work.

6. Reaching

   a. Use a safe footstool/ladder whenever needed.

   b. Stand close to object.

   c. Place feet wide apart, one in front of the other, so you have freedom of movement.

   d. Keep good body alignment. Move close to object. Do not reach outward to the point of straining.

   e. When reaching for an object which is above the head, grip it with palms up and lower it. Keep it close to the body on the way down.

Chapter 6 Safety Program Recommendations: Personal Protective Equipment

INTRODUCTION

Personal protective equipment should never be considered the first line of defense in hazard elimination. Instead, this equipment should be considered as "back-up" protection for the unexpected or the unusual. Preparedness for the unexpected thus becomes a personal matter involving two distinct objectives:

1. The generation of safety consciousness or conditioning toward personal protection

2. The selection and provision of the best possible and most reliable type of protective equipment

When selecting personal protective equipment the following considerations should be reviewed to insure appropriate decisions (6, pp. 14.4-14.7):

1. The degree of hazard must be ascertained
2. The degree of protection required in relation to the seriousness of hazard
3. Interferences must be balanced against protection
4. Costs should be weighed against service life

In addition, care should be taken to avoid the typical problems that interfere with the effectiveness of personal protective equipment (6, pp. 14.7-14.9):

1. Purchasing different brands of a particular safety item
2. Insufficient or improper personal protective equipment maintenance
3. Improper fit
4. Insufficient training for the use of personal protective equipment
5. Equipment of unknown quality (all equipment should be clearly marked as to conformity with NIOSH, ANSI, or other standards)

EYE AND FACE PROTECTION

Types of Hazards

One of the best starting points for establishing the habit of using personal protective equipment is to encourage the use of appropriate eye and face protection. By Missouri law, eye protection must be provided and students and instructors must wear this equipment in practical arts and vocation technical education courses where there is a reasonable probability of injury. In most vocational facilities there are special

hazards that make eye protection a major concern. These hazards include chemicals, harmful rays and impact. Table V classifies many of such hazards by the vocational subject being studied.

Chemical Hazards. These include areas where spraying, cleaning, and application of hazardous materials such as acids occur. Special splash-resistant goggles should be worn in these areas. Face shields and acid hoods are advisable as they give additional protection to the face and mucous areas (32, p. 5).

Harmful Rays. Light-duty glare typically occurs with gas welding, graphic arts, photography, and strong sunlight. Spectacles or goggles that conform to specifications in regard to tint (e.g., the welding recommendations provided in Table VI) are a vital means of eye protection. They also permit comfortable observation of such operations by student and instructor.

Heavy-duty glare includes the effect of ultraviolet and infrared radiation. Radiation of this type can cause permanent injury to the eyes unless they are protected by special lenses (32, p. 5).

Impact Typical Hazard Areas include grinding, chipping, machinery, buffing, and polishing. Goggles made with proper glass, wire mesh, or plastic; or spectacles with side shields which comply with regulating codes (Mo. 170.005, Mo. 170.007) should be worn to reduce this danger (32, p. 5).

Eye Injury First Aid

In the event of an eye injury vocational instructors should immediately seek professional medical treatment for the injured. Occasionally first aid will be desirable while waiting for a doctor's treatment. In these cases, instructors are then advised to seek the services of a school nurse. If instructors find it necessary to administer first aid themselves, the recommendations in Figure 10 provide a useful guide.

Types of Eye and Face Protection

All equipment must be designed to provide adequate protection against the particular hazards to which the person is exposed. Furthermore it must be distinctly marked to identify the manufacturer and the particular code the device meets. Instructors and administrators should establish an eye protection program in laboratories in which every person, including teachers, students and visitors, must wear required eye protection at all times while in the shop or laboratory. Only protective eye wear of industrial quality as specified by the American National Standards Institute (ANSI) should be used. The ANSI standards cover such important features of protective eye wear as lens thickness, lens penetration resistance, lens retention, optical quality, flame resistance of the frame, sterilizability, warp resistance, and so on (8, pp. 84, 85).

TABLE V

Vocational Curricula, Eye Hazards and Eye Protection Recommendations

The following chart lists some operations and activities commonly conducted in vocational education, science, and fine arts instructional settings, their eye hazards and methods of protection. The chart is not meant to be all-encompassing or exhaustive but is designed to provide general guidance.

ACTIVITY OR OPERATION	EYE HAZARDS	EYE PROTECTIVE DEVICE(S)
Autobody		
Body preparation	Flying particles	Spectacles with attached sideshields or shop goggles; add face shield for severe exposures
Painting, mixing and chemical preparation	Splashing, mists	Chemical goggles
Welding (see WELDING SECTION)		
Auto/Power Mechanics		
General operations	Flying chips, particles, dust	Spectacles with attached sideshields or shop goggles; add face shield for severe exposure
Lubricating, spray painting, steam and solvent cleaning	Grease, hot steam, mists, splashing	Chemical goggles
Battery servicing	Acid, sparks, explosion	Chemical goggles
Welding (see WELDING SECTION)		
Carpentry		
General operations	Flying chips, particles, objects	Spectacles with attached sideshields or shop goggles; add face shield for severe exposure
Chemicals, solvents	Splashing, mists	Chemical goggles
Ceramics/Enameling		
Kiln, firing, dry mixing, glass fritting, throwing	Flying clay, particles, dust, explosion (firing)	Spectacles with attached sideshields or shop goggles; add face shield for severe exposure
Commercial Art		
Air brush, spray painting, chemical mixing, solvents, photographic solutions	Pressurized sprays, splashing	Chemical goggles
Commercial Foods		
Food frying	Hot grease splashing	Chemical goggles
Equipment cleaning agents (i.e., oven cleaners, degreasers)	Splashing, pressurized sprays	Chemical goggles
Electricity/Electronics		
General operations	Flying chips, solder splash breaking glass	Spectacles with attached sideshields or shop goggles
Cathode tube servicing	Implosion, flying glass	Spectacles with attached sideshields or shop goggles with face shield
Chemical etching	Acid splashing	Chemical goggles
Foundry		
Core and moldmaking, chipping, grinding, general operations	Chips, flying particles	Spectacles with attached sideshields
Heating, melting and pouring metal	Splashing, sputtering, explosion	Foundry/melters goggles with tinted plastic lens and full face shield
Graphic Arts		
Cutting, stitching, drilling	Flying objects	Spectacles with attached sideshields or shop goggles
Chemical mixing, solvents, photographic solutions	Splashing	Chemical goggles

Table V, continued

ACTIVITY OR OPERATION	EYE HAZARDS	EYE PROTECTIVE DEVICE(S)
Home Economics		
Food frying	Flying hot grease	Chemical goggles
Chemical Cleaners	Splashing, mists, pressurized sprays	Chemical goggles
Jewelry/Art Metal		
Silver soldering, chasing and smelting, hammering	Sputtering metal, sparks, flying objects	Shop goggles
Leatherwork		
Carving, stamping, cementing, buffing	Flying particles	Spectacles with attached sideshields or shop goggles
Masonry/Mosiac Tile		
Cutting, grinding, chipping	Flying chips, particles, and dust	Spectacles with attached sideshields or shop goggles
Acid or cleaning solutions	Splashing	Chemical goggles; add face shield for severe exposure
Metal Working		
General operations	Flying chips, particles, dust, and objects	Spectacles with attached sideshields or shop goggles; add face shield for severe exposure
Pickling, etching, solvents	Splashing, mists	Chemical goggles
Plastics		
General operations	Flying chips, particles, dust	Spectacles with attached sideshields or shop goggles
Extruding, heating, pouring mixing	Splashing	Chemical goggles
Science		
Chemical handling, experimenting, glass handling, dissecting	Splashing, flying particles	Chemical goggles
Laser experiments	Severe retinal burns, operators	In Compliance with ANSI Z136.1-1976, "Safe Use of Lasers"; or later revision thereof
Welding		
Electric arc	Welding flash, sparks, sputtering, molten metal, air bubble explosions	Welding helmet with filter lens (see Appendix C) over spectacles with attached sideshields
Gas welding, cutting, burning, and metalizing	Flying sparks and metal	Welding goggles over safety spectacles with attached sideshields
Chipping, grinding	Flying chips, slag and particles	Spectacles with attached sideshields
NOTE: Use protective curtains and screens to safeguard others in		
Woodworking		
General operations	Flying chips, particles, dust and objects	Spectacles with attached sideshield or shop goggles; add face shield for severe exposure
Chemicals, solvents, finishing materials	Splashing, pressurized sprays	
Visitors		
All areas	Variable	Appropriate for exposure

Eye Protection in Educational Institutions. New Jersey State Department of Education (29).

TABLE VI

Selection of Shade Number for Welding Filters

The following is a guide for the selection of the proper shade numbers of filter lenses or plates used in welding. Shades more dense than those shown for various operations may be selected to suit the individual's needs.

Welding Operation	Suggested Shade Numbers*
Shielded Metal-Arc Welding, up to 5/32 in. (4mm) electrodes	10
Shielded Metal-Arc Welding 3/16 to 1/4 in. (4.8 to 6.4mm) electrodes	12
Shielded Metal-Arc Welding, over 1/4 in. (6.4mm) electrodes	14
Gas Metal-Arc Welding (Nonferrous)	11
Gas Metal-Arc Welding (Ferrous)	12
Gas Tungsten-Arc Welding	12
Atomic Hydrogen Welding	12
Carbon Arc Welding	14
Torch Soldering	2
Torch Brazing	3 or 4
Light Cutting, up to 1 in. (25mm)	3 or 4
Medium Cutting 1 to 6 in. (25 to 150mm)	4 or 5
Heavy Cutting over 6 in. (150mm)	5 or 6
Gas Welding (Light) up to 1/8 in. (3.2mm)	4 or 5
Gas Welding (Medium) 1/8 to 1/2 in. (3.2 to 12.7mm)	5 or 6
Gas Welding (Heavy) over 1/2 in. (12.7mm)	6 or 8

*The choice of a filter shade may be made on the basis of visual acuity and may, therefore, vary widely from one individual to another, particularly under different current densities, materials, and welding processes. However, the degree of protection from radiant energy afforded by the filter plate or lens when chosen to allow visual acuity will still remain in excess of the needs of eye filter protection. Filter plate shades as low as shade 8 have proven suitable radiation-absorbent for protection from the arc-welding processes.
NOTE: In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the operation (spectrum).

(Excerpted from the American National Standard Practice for Occupational and Educational Eye and Face Protection, Z87.1-1979).

FIGURE 10

First Aid

For Eye Injuries Before Competent Medical Help is Obtained

NOTE: NO MATTER HOW MINOR THE INJURY, PROFESSIONAL MEDICAL TREATMENT MUST BE OBTAINED AS SOON AS POSSIBLE.

NOTE: DETERMINE IF THE VICTIM IS WEARING CONTACT LENSES—THEY MUST BE REMOVED BEFORE FIRST AID IS ADMINISTERED

SPECKS IN THE EYE

DO lift upper eyelid outward and down over the lower lid.
DO let tears wash out speck or particle.
DO if particle doesn't wash out—keep eye closed, bandage lightly and see a doctor.
DO NOT rub the eye.
DO seek professional medical treatment as soon as possible.

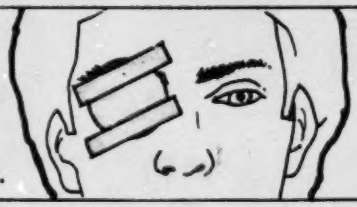
BLOWS TO THE EYE

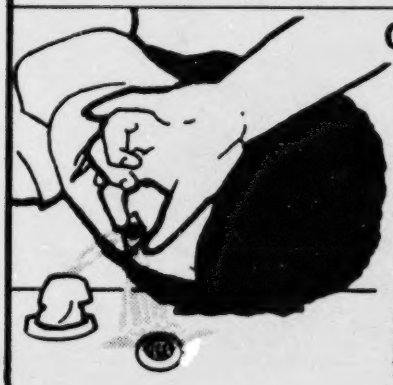
NOTE: Discoloration (black eye) could mean internal damage to eyes.

DO apply cold compresses immediately, for 15 minutes; again each hour as needed to reduce pain and swelling.
DO seek professional medical treatment as soon as possible.

CUTS AND PUNCTURES OF THE EYE OR EYELID

DO bandage lightly.
DO NOT wash eye with water.
DO NOT try to remove an object imbedded in the eye.
DO seek professional medical treatment as soon as possible.





CHEMICAL SPLASHES

Eye damage from chemicals may be extremely serious, as from alkalis or caustic acids; or less severe, as from chemical "irritants."

In all cases of eye contact with chemicals:

DO flood the eye with water immediately, continuously and gently, for at least 15 minutes. Use eyewash fountain, hold head under faucet or pour water into the eyes using any clean container. Keep eyelids open as widely as possible.
DO NOT use an eye cup.
DO NOT bandage the eye.
DO seek professional medical treatment as soon as possible.

NOTE: Spray containers are an increasing source of chemical eye injury compounded by the force of contact. Whether containing caustic or "irritants," spray containers must be carefully used with proper instruction and supervision.

*From Eye Protection in Educational Institutions. New Jersey State Department of Education, 1980.

Missouri's Department of Elementary and Secondary Education provides a reprint shown in Figure 11 that summarizes the state's eye protection law as well as illustrating some suggested types of protective devices. A brief description of various types of eye and face protection, along with suggestions for their use and information on some limitations follows:

Goggles -- Goggles consist of a pair of contour-shaped eyecups with glass or plastic lenses. They are held in place by a headband for the protection of eyes and the eye sockets. There are several types of goggles (8, pp. 85, 86):

- Flexible-Fitting Goggles. Flexible-fitting goggles protect against fine dust, fumes, liquids, splashes, mists, and sprays. The frame is composed of a flexible, chemical-resistant, non-toxic, nonirritating, slow-burning material forming a lens holder. Flexible-fitting goggles are usually ventilated to prevent fogging. In some cases, the ventilation is designed to make the goggles splash-proof.

- Melters' Goggles. These consist of a mask made of flexible, nonirritating, and noncombustible or slow-burning material, metal lens holders, lenses, and a positive means of support on the face. The edge of the mask in contact with the face is provided with a binding of corduroy or other suitable material. These goggles are used to provide protection against glare and impact and hot metal splash hazards encountered in foundry operations, such as melting, pouring, chipping, babbitting, grinding and riveting. They are also designed to provide protection against dust.

Spectacles -- Safety spectacles are patterned after conventional eyeglasses but are of more substantial construction, either with or without side shields and with impact-resistant lenses. Clip-on side shields are available for easy conversion of spectacles for front and side protection. Lenses may be clear or filtered, glass or plastic. Corrective safety lenses may also be mounted in spectacles with safety frames, provided the lenses are tempered to meet the proper impact standards. Safety glasses are now available with prescription lenses. Two types of spectacles are described below (8, pp. 86, 87):

- Metal, Plastic or Combination Frame Spectacles. Spectacles are intended to provide protection from flying objects, glare, and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side protection is also necessary, the spectacles should be provided with side shields made of metal or slow-burning plastic materials. Spectacles are used for light chipping operations, for grinding, for machine tool operations, and for other jobs involving flying object hazards. When provided with filter lenses, they may be used for furnace operations, under face shields when handling molten metal, spot welding, and work adjacent to welding.

Figure 11

STATE LAW REQUIRES EYE PROTECTION

In accordance with Sections 170.005, 170.007 and 170.009 RSMo.:

170.005. Eye Protection—who affected. — Every student, teacher and visitor is required to wear an industrial quality eye protective device when participating in or observing any of the following courses in schools, colleges, universities or other educational institutions:

(1) Vocational, technical, industrial arts, chemical, or chemical-physical shops or laboratories involving exposure to the following: hot molten metals, or other molten materials; milling, sawing, turning, shaping, cutting, grinding or stamping of any solid materials; heat treatment, tempering, or kiln firing of any metal or other materials; gas or electric arc welding, or other forms of welding processes; repair or servicing of any vehicle; caustic or explosive materials;

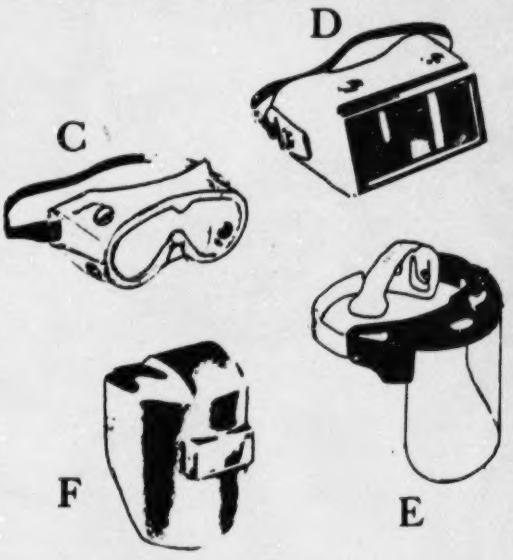
(2) Chemical, physical, or combined chemical-physical laboratories involving caustic or explosive materials, hot liquids or solids, injurious radiations or other hazards not enumerated. *(SB 519, 78th General Assembly, Second Regular Session)*

170.007. Standards for Protective Devices. — As used in this act, "Industrial Quality Eye Protective Devices" means devices meeting the standards of the American National Standard Practice for Occupational and Educational Eye and Face Protection, Z87.1—1968, and subsequent revisions thereof, approved by the American National Standards Institute, Inc. *(SB 519, 78th General Assembly, Second Regular Session)*

170.009. Implementation of Eye Protection Act. — The state board of education and the coordinating board for higher education shall prepare and circulate to each public and private educational institution in this state instructions and recommendations for implementing the eye safety provisions of this act. *(SB 519, 78th General Assembly, Second Regular Session)*

SUGGESTED COMMON EYE PROTECTORS

Devices must comply with the above standards.



GENERAL SELECTION GUIDE

HOT MOLTEN METALS	A + E
MILLING, SAWING, TURNING, SHAPING, CUTTING, GRINDING OR STAMPING OF SOLID MATERIALS	A OR B
HEAT TREATMENT, TEMPERING, KILN FIRING	A + E
GAS WELDING	D
ARC WELDING	F
VEHICLE REPAIR AND SERVICE	A OR B
CAUSTIC OR EXPLOSIVE MATERIALS CHEMICAL SPLASH OR DUST	C OR A + E

All eye protection equipment worn must meet standards of the American National Standard Institute (A.N.S.I.) Practice for Occupational and Educational Eye and Face Protection, Code Z87.1-1968, or later revisions of this Code. Most prescription glasses do not meet the standards necessary for the protection of the individuals as prescribed in the law.

Publication of Department of Elementary and Secondary Education.

- Plastic Eyeshield Spectacles -- Plastic eyeshield spectacles have similar features and are used under the same conditions as plastic or metal frame spectacles although they are not as durable as the latter.

  Special Note -- Differences between street and safety eyewear (29, p. 4).

  - Safety lenses have greater thickness than standard lenses to help resist breaking.
  - Safety lenses are manufactured or treated to give greater strength.
  - Safety lenses are fitted into the front of the frame to prevent the lens from being pushed into the eyes in the event of impact.
  - The frames of safety spectacles are made of special materials for greater strength and flame resistance.
  - Safety spectacles are equipped with side shields which afford added protection.

- Prescriptions -- Persons who require vision correction should be encouraged to obtain prescription safety glasses. When students wear prescription spectacles which do not have safety lenses in safety frames, an appropriate cover goggle should be worn over the regular glasses as protection against shattering of the unhardened lenses. However, because of their added cost, prescription safety glasses should also be protected against pitting, e.g., during grinding operations, by a face shield, cover goggles, or lightweight disposable plastic clip-ons. Typically such cover goggle frames are molded in a flexible or rigid material with headbands that consist of an elastic/adjustable strap which can be replaced at a very nominal cost.

Contact Lenses

"Wearing Contact Lenses in Welding Labs Can Be Dangerous." An Advisory Committee on Industrial Eye Health and Safety of the National Society to Prevent Blindness has issued a statement on the use of contact lenses in eye hazardous work areas that school administrators, and vocational instructors in particular, are advised to carefully consider. Although the information is directed to industrial settings, the precautions would seem to apply equally to students and staff in school shops and laboratories.

"Because of increased risk to the eyes, the National Society to Prevent Blindness strongly advises that the use of contact lenses of any type by industrial employees while at work should be prohibited, except in rare cases. The National Society recommends that any exceptions be verified in writing to the employer by the physician or optometrist who sanctions such use in a specific industrial environment. Contact lenses do not provide eye protection in the industrial sense; their use without eye and/or face protective devices of industrial quality should not be permitted (29, p. 5).

Since contact lenses rest on the fluid of the eye, dust particles, fumes, smoke, and gases can become lodged between the lens and the eye. Particularly in welding areas, with their prevalence of flash conditions, students are susceptible to flash burn.

Welding Helmets and Hand Shields

Helmets and hand shields are designed to provide protection against intense radiant energy not only for the eyes, but also for the face, ears, and neck. Typical operations which require helmets or hand shields include various kinds of arc welding and heavy gas cutting. Two types are described below (8, pp. 87-88):

> Helmets. Because of the area to be protected, the helmet body is of such size and shape as to protect the face, top of the head, and the neck to a vertical line back of the ears. It has an opening or openings in the front for a filter plate and cover plate. The helmet body is supported so that it does not come in contact with any part of the head and can be lifted up from in front of the face to allow the welder to examine the weld. Helmet bodies are made of vulcanized fiber, reinforced plastic, or other suitable flame-resistant material that is opaque to ultraviolet and infrared radiations and also able to be disinfected. Rivets or other metals parts, if terminating on the inside surface, are insulated. Helmets must conform to ANSI standards.
>
> Hand Shields. Hand shields are used in some welding operations or for observing the welding process. A handle made of nonconducting, noncombustible or slow-burning material is provided. Both the materials and the lens mounting arrangement, filter and cover plates are similar to those for the helmet. Hand shields also must conform to ANSI standards.

Face Shields

Face shields are typically designed to provide protection to the face from flying particles, sprays of hazardous liquids and to provide antiglare protection when needed. Plastics used in face shields should combine a high degree of mechanical strength with low weight, be nonirritating to the skin when exposed to perspiration, and be capable of withstanding frequent disinfection as well as being slow-burning. Clear or colored plastic materials used in windows should be of an optical grade to provide equivalent performance with the optical, physical, and radiant energy requirements specified for other eye protectors. When face shields are to be used in atmospheres or working areas requiring special condition of nonconductivity or nonsparking, all materials used should be made to meet these requirements and plainly and permanently labeled as "nonconductive face shield" or "nonsparking face shield" (8, p. 88).

Some typical uses for face shields include woodworking operations where chips and particles fly, metal machining that causes flying particles or objects which may strike the face, spot welding, and the handling of hot or corrosive materials. Note that shields are not acceptable for protection against heavy flying objects, for welding and cutting, or against intense radiant energy. In such cases, where additional facial protection may be needed, face shields can be worn over appropriate goggles.

Care of Eye and Face Protective Equipment

General Information. Effective eye protection requires clean lenses. Dirty lenses blur vision and will eventually cause eye strain. Lenses should be cleaned daily with a solution of warm water and soap or a cleaning solution and then wiped dry. Pitted or scratched lenses can also reduce vision and should be replaced. The molded-plastic-framed goggles readily permit lens replacement, but spectacle-type frames require professional skill to replace. When not in use, keeping goggles and/or spectacles in their cases will extend their life span. Often the plastic bag or box in which they were shipped provides an ideal dust-proof container for protection, however, commercial storage devices are also available (8, pp. 88, 89).

Cleaning and Disinfecting. Mere provision of safety eye protection is not sufficient. Eye protective devices which are shared shall be disinfected between uses. The disinfecting method shall be prescribed by the local school medical inspector. For information note the following proceudres and methods as obtained from the ANSI Z87.1 requirements (29, p. 5):

1. "Thoroughly clean all surfaces with soap or suitable detergent and warm water. Carefully rinse all traces of soap or detergent. Completely immerse the protector for 10 minutes in a solution of modified phenol, hypochlorite, or quaternary ammonium compounds, or other disinfectant reagent, in a strength specified by the manufacturer of the safety equipment, at a room temperature of 20°C (68°F). Remove protector from solution and suspend in a clean place for air drying at room temperature, or with heated air. Do not rinse because this will remove the residual effect."

2. "Ultraviolet disinfecting equipment may be utilized in conjunction with the preceding washing procedure, when such equipment can be demonstrated to provide comparable disinfection."

3. "Spraying-type disinfecting solutions and bactericides may be utilized when such pressurized spray solutions can be demonstrated to provide comparable disinfection with the immersion procedure outlined above."

4. "Protectors showing need for extensive cleansing should be disassembled to the extent possible without tools, prior to the washing and disinfection procedure. Replace defective parts with new ones. The dry parts or items should be placed in clean, dustproof containers to protect them."

RESPIRATORY PROTECTION

There are hazardous areas where students may be required to wear personal respiratory devices. These devices consist of a mesh which covers the nose and mouth and a filtering device which cleans the air (32, p. 7). Approved respirators must be provided by the school when the workplace air is contaminated with excessive concentrations of harmful dusts, fumes, mists, gases, or vapors. Respirators may be used as a control only when engineering or administrative controls are not feasible, or while they are being implemented (11, p. 73).

Types of Respirators

There are two types of respiratory protective devices:

(a) air purifiers, which remove the contaminant from the air by filtering or chemical absorption before inhalation.

(b) air suppliers, which provide clean air from an outside source or oxygen from a tank. Full details of approved types should be obtained from the manufacturer.

Filter respirators typically cover the mouth and nose but do not protect the eyes. For dust protection, choose a respirator that meets the requirements for high filtering efficiency and low resistance to breathing.

Air line respirators are usually preferable to chemical cartridge or mechanical filter respirators, because they are cooler, offer more positive protection, and offer no resistance to breathing. However, they require a proper compressor and regulator to supply fresh air.

Selection of Respirators

Among the many factors to be considered in the selection of the proper respiratory protection device for any given situation involving air contamination are the following (6):

1. The nature of the hazardous operation or process
2. The type of air contaminant, including its physical properties, physiological effects on the body, and its concentration
3. The period of time for which respiratory protection must be provided
4. The location of the hazard area with respect to a source of uncontaminated respirable air
5. The health of personnel involved
6. The functional and physical characteristics of respiratory protective devices

If respirators are used, the overall documentation of the safety program should include written descriptions that establish the following:

1. That the respirators selected for use are designed to protect against the specific hazards to which people are exposed

2. Written instructions that pertain to the use and availability of respirators

3. Student training in the limitations of respirators as well as their proper fitting and maintenance

4. Respirator cleaning schedules and procedures

5. When the respirator is worn, all straps must be adjusted and tied to ensure proper function of the respirator because a good face seal is necessary. Beards, long sideburns, and glasses may interfere with the fit.

6. Schedules/procedures for filter, cartridge or canister replacement when they have been used for the specified lifetime, when the wearer can smell vapors in the mask, or if breathing becomes difficult (8, p. 92)

Respirator Cleaning and Inspection

The following procedure is suggested for cleaning and disinfecting respirators (8, pp. 92,93):

1. Remove any filters, cartridges or canisters.

2. Wash facepiece and breathing tubes in a cleaner-disinfectant solution. Use a hand brush to facilitate removal of dirt.

   Examples: Reliable disinfectants may be made from some available household solutions (24, pp. 40-41)
   - Hypochlorite solution (50ppm of chlorine) made by adding approximately two tablespoons of chlorine bleach per gallon of water. A two-minute immersion disinfects the respirators.

   - Aqueous solution of iodine (50ppm) made by adding approximately one teaspoon of tincture of iodine per gallon of water. A two-minute immersion is sufficient and will not damage the rubber and plastic in the respirator facepiece.

3. Rinse completely in clean, warm water.

4. Air dry in a clean area.

5. Clean other respirator parts as recommended by manufacturer.

TABLE VII

Respirator Inspection Checklist

Component	Examine for	Remedy
Facepiece	Cracks, tears, holes	Replace
	Melting or stiffening	
	Distortion	Place facepiece on shelf free from any restraints. If distortion is removed, the facepiece may be placed in service. If not, replace it.
Headband	Breaks, frays or tears	Replace
	Loss of elasticity	Replace
	Missing or bent hardware	Obtain new hardware from distributor or manufacturer
Inhalation Valve	Dust or dirt on valve	Clean
	Dust or dirt on valve seat	Clean
	Missing valve flap	Replace
	Cracks or tears in valve material	Replace
	Distortion or stiffening of valve material	Replace
Exhalation System	Dust or dirt on valve	Clean
	Dust or dirt on valve seat	Clean
	Missing valve flap	Replace
	Missing valve cover	Replace
	Cracks or tears in valve material	Replace
	Distortion or stiffening of valve material	Replace
	Distorted, scratched or cracked valve seat	Replace
Filter or Cartridge	Appropriate for containment	Replacement with correct element
Cartridge	Worn threads	Replace
	Cracks in housing	Replace
	Accumulation of paint	Replace
Filter	Accumulation of paint	Replace
Cartridge Gasket	Worn or missing	Replace
	*None required on HSC respirator	

(24, p. 40)

6. Inspect valves, headstraps, and other parts; replace with new parts if defective. Table VII provides recommendations for the inspection procedure.

7. Insert new filters, cartridges or canisters; make sure seal is tight.

8. Place in a plastic bag or other container for storage.

HEARING PROTECTION

Noise levels in some vocational areas may exceed the 90 dBA limit. When this occurs it is desirable to implement noise controls providing equipment for hearing protection. Such ear protectors are designed to filter out and absorb harmful noise of both high and low frequency. Ear muffs may be foam-filled or grease-filled. The latter cost somewhat more but are generally the most effective in reducing sound levels. Ear muffs are substantially more expensive than ear plugs and are more bulky, but are sometimes more comfortable to wear. Ear muffs seal out noise by providing a tight fit around the ear (8, p. 89).

Ear plugs alone significantly reduce noise at the eardrum. Ear plugs should be individually fitted to the wearer and and the school nurse can usefully assist in fitting students with ear plugs. Since ear plugs are somewhat difficult to detect from a distance, regular inspections should be made to ensure that they are being worn where needed. The protection from noise by ear plugs is typically somewhat less than that provided by ear muffs (8, p. 89).

HEAD PROTECTION

Impact Protection

In the vocational shop or laboratory, head injuries due to falling objects are usually minimal. However, in facilities with mezzanines such possibilities need to be guarded against. Head protection must be available when a class is taking part in building construction or any place where a boom might be used to raise objects overhead. Generally, "hard hat" protection should be provided whenever there is danger of falling or flying objects (32, p. 4).

Hard hats are usually high impact-resistant shells of aluminum, fiber-glass, phenolic, or polycarbonate that distribute impact evenly

and then absorb it by means of a web suspension system. Federal specifications require 1-1/4" clearance between the wearer's head and the protective shell. Adjustable webbings with perforated headband provide for comfort and coolness. A nape strap should be included to keep the headgear from falling off (30, p. 6).

Head protection of this type must meet the recommendations in ANSI Z89.1-1969* for protection against the type of hazard expected. Typically vocational education would use one of the following (8, p. 89):

- Type 1 - Helmet, full brim
- Type 2 - Helmet, brimless, with peak
- Class A - Limited voltage protection
- Class C - No voltage protection
- Class D - Limited voltage protection, fire fighters' service, Type 1 only

Each helmet must be identified on the inside of the shell in letters not less than 1/8 inch high, with the name of the manufacturer and the ANSI designation and class. For example: Manufacturer's name, ANSI Z89.1-1969, Class A (8, p. 90).

Hair Protection

As contemporary hair styles tend to bring longer hair into vocational laboratories, accidents have increased to the extent that partial scalpings are occuring with greater frequency. In some instances, heads have been drawn into machines and occasionally this was a result of snagging a single strand of hair! Hair control should be required when hair is of a length that the operator's safety might be endangered. Suitable protection involves caps and/or bands with which hair can be restrained to prevent entanglement.

In welding or other areas where sparks or flames are present, fire resistant coverings should be provided for the hair. These coverings may be without visors and they should be worn under welding helmets (32, pp. 4,5).

Hair can also become a problem to persons who need to keep their work environment free of such material. For example, in health occupations or the culinary arts, body hair must be prevented from contaminating procedures or work. These instances require the use of a hair cap/net to confine and contain hair on the head.

FOOT PROTECTION

Without exception, students shall wear shoes in vocational areas at all times. Materials-handling accidents and cuts and punctures are common vocational hazards which can be prevented by wearing proper footwear.

*Class B - High voltage protection, not included in this standard.

It is recommended that shoes have leather or rubber soles with full leather or fabric cover for the entire foot up to the ankles. Canvas deck shoes or basketball shoes offer very little protection for the foot and shall be limited to light work in the shop. Safety shoes and steel foot guards are available to prevent the crushing of feet and toes. In areas where water and moisture are present, rubber and non-slip boots should be provided to prevent falls and to act as a non-conductor of electricity (30, p. 7).

HAND AND BODY PROTECTION

Proper laboratory clothing should be worn to protect street clothing. The following characteristics are desirable for laboratory clothing (32, p. 6):

1. Comfortable but not loose
2. Provisions to fasten long sleeves at 1/4 arm length
3. Machine washable
4. Wear resistant
5. Heavy enough to provide protection from chips and sparks
6. Non-flammable material for vocational courses

Such protection usually consists of gloves, hand leathers, aprons, coveralls, and shop coats. These items serve as a significant part of the total personal protective program.

Gloves and Hand Leathers

Gloves and arm protectors should be used to prevent lacerations from handling objects with sharp edges, to prevent contact with chemicals, or to prevent burns.

Canvas or heavy cotton work gloves are usually worn if the main hazard is blisters due to friction. Such protection is inexpensive and easily procured. When heat is involved, a more protective type of glove or mitten must be worn. For welding, a leather glove extending well over the wrist is recommended. Some of the more durable ones are made of cowhide or horsehide. Hand guards or leathers are usually of a special design to reduce hazards when handling material with sharp edges, such as sheet metal or steel. They consist of a pad of leather which covers the palm of the hand and fingers, yet permits maximum hand flexibility. For protection against acids, caustics, solvents, and petroleum products, an appropriate impermeable glove, available in various types of rubber or plastic, should be used. Such gloves can be purchased in wrist or gauntlet length as required (11, p. 72). Care should be taken when working on machinery. Usually this provides an opportunity for gloves to be drawn into the machine and, with the gloves, the hands. For this reason, the wearing of gloves while operating machines is typically not a desirable practice.

Aprons

Aprons, available in a variety of materials, may be either the bib type covering the body from the chest down to the knees/ankles or from the waist down. Aprons protect against sparks, hot metal splashes, and splashing liquids depending on the material from which they are made. Loose aprons are extremely hazardous around revolving or reciprocating machinery and should not be permitted (11, p. 73).

Coveralls

Coveralls protect the body except for the hands, head, and feet. Overalls include a "bib", but do not have sleeves as provided in coveralls. Desirably they are made from a rugged material to withstand hard and long wear. Coveralls and overalls provide body and clothing protection and hence are recommended for vocational areas where this is desirable, e.g., building construction jobs, automotives, agricultural mechanics and the like (11, p. 73).

Shop Coats

Shop coats also provide general body and clothing protection. Frequently they are used to guard against grease and dirt, but more specifically, they can also serve as protection from chemicals and hot substances. Since coats with sleeves should not be used when working around moving machinery, the short-sleeve wraparound knee-or hip-length serves well for general laboratory or shop use (11, p. 73).

RADIATION SAFETY

Health occupations curricula, energy technologies and material testing involve increasing use of radiation equipment. Therefore, it is important to be aware of the safety concerns that apply to the uses of radiation. Among the primary safety measurements in the field of radiation, the level or amount of radiation and the time of exposure are critical. A number of different monitoring devices are available and are required to be used by persons exposed to the hazards. Due to the number and complexity of safeguards and regulations concerning radiation, in-depth information cannot be fully presented in a document such as this guide. It is imperative therefore that if vocational situations involve the use of equipment/processes with potential radiation hazards that the specific application and protective procedures be reviewed by a knowledgeable consultant. These persons can be identified by state curriculum supervisors, safety agency representatives, and even the equipment manufacturers. Detailed assistance in this area may be obtained from Missouri's Bureau of Radiological Health as referenced in the Resource Agency section of this safety guide.

Chapter 7 Safety Program Recommendations: Vocational Special Needs Students

As a people, we believe in the right of individuals to a free and appropriate public education. Since every individual has special needs, educators need to tailor the education process to these needs. This is particularly important in the arena of practical arts and vocational technical education safety. There student learning and well-being depends upon the teacher's approach to the safety of the learning environment. This section has attempted to consolidate available safety recommendations and considerations for the special needs student in practical arts and vocational technical education courses. Because of the need for specific assurance, instructors are additionally advised to consult special needs experts, particularly those versed in the specific disability involved, safety consultants, medical practitioners where appropriate, and in all cases, the child-study team responsible for each special needs student's individualized educational plan (IEP).

The available information has been placed in a grid format (Table VIII) that is organized with categories of special needs across the top (hearing impaired, learning disabled, mentally retarded, physically handicapped, and visually impaired) and specific safety topics (facilities, equipment, fire/evacuation, classroom instruction/shop work, and materials) along the vertical axis. By aligning a student's handicap with a safety topic, instructors can identify suggested adaptations and precautions to meet specific students' needs. Because the recommendations represent sound educational methods, many could and should be used to the advantage of all students.

Example: An instructor enrolls a deaf student in a vocational class. To see what machinery changes are needed, by using the grid's "hearing impairment" column and by locating the specific topic (row) dealing with machinery, one identifies some suggested steps a vocational instructor can take. In this case, as a part of making the laboratory safer for deaf students, it is recommended to:

- install warning lights on equipment to signify when power is on and off.
- avoid total sound absorption.
- provide visual and aural emergency signals and to rehearse procedures.

Individualized Educational Plan Development

An individualized educational plan (IEP) must be provided for each classified special needs student. The program specifies those educational and related services which are to be provided for the student, methods of assessing progress and the like. In developing an IEP, the educational agency and the student, along with parents or guardians, explore together the student's needs, the ways these needs may be met, and which educational needs have the highest priority. Since instructional strategies are part of this process, when child-study teams consider vocational placement for a student, it is vital to his/her safety that the appropriate vocational instructor be involved in both

TABLE VIII

Suggestions for Increasing the Safety of Vocational Education as it Serves Special Needs Students

	Hearing Impaired	Learning Disabled	Mentally Retarded	Physically Handicapped	Visually Impaired
Facilities	Avoid total sound absorption in wall design Visually and aurally signaled emergency mechanisms and rehearsed evacuation procedures	Color contrast of machines, areas, and tools Use of generalizeable symbols to denote special safety concerns	Use of generalizeable symbols to denote special safety concerns	Counter/workbench heights should be designed for safety and comfort. Adjustable benches are desirable Extra aisle and work space for accessibility to all areas as needed Reachers (extension poles, grippers) where needed Doors with kick plates and vision panels Handrails/guardrails as appropriate Easy to use (i.e. knurled or looped) handles on doors, gates, drawers etc. Faucets with dials for specific temperatures Foot- or elbow-controlled faucets	Supplemental lighting Raised letters or Braille signs and tags, large print A place for everything (i.e. standardized organization) Handrails/guardrails as appropriate Directive aids (raised lines, knobs, textured flooring, concrete, etc.) Special spatial orientation to facilities and location of safety features Wide and uncluttered aisles Relocate, recess or remove protrusions in walk areas (water fountains, fire extinguishers, etc.)

Material adapted from the following sources:
Bruwelheide, K., Assisting the Physically Handicapped, Montana State University, Bozeman, MT (3)
Greenan, J. P., Leadership Training Institute/Vocational and Special Education, University of IL Urbana-Champaign
Safety Guide for the Handicapped, ITT, 1979 (15)
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Razeghi, J. A., "Analyzing, Modifying and Selecting Vocational Materials for Research," Journal of Vocational Special Needs Education, April 1980

TABLE VIII, continued

	Hearing Impaired	Learning Disabled	Mentally Retarded	Physically Handicapped	Visually Impaired
Classroom instruction/ shop work	Accessory hearing aids Use gestures liberally Speak clearly without shouting Avoid masking mouth Provide a written list of words that will be encountered on the job Use handouts to minimize note-taking (attention should be directed to the instructor) Face-to-face communication Peer tutors Visual aids	Repetition Give special attention without overdoing it Provide positive reinforcement Provide ample practice Avoid time pressure and stressful situations Ascertain practical attention span and keep work activity within this limit Vocabulary lists Peer tutors Self-instructional material Appropriate reading levels	Simplify instruction. Be clear! Repetition Use pictures, posters, reminders Assembly line-type sequences may be useful Review rules more carefully and frequently Use small, short steps in instruction Use concrete/ tangible teaching methods Use simplified procedures to accomplish work tasks Rehearse instructions Use positive reinforcement Ascertain practical attention span and keep work activity within this limit	Position students for adequate viewing of instructors and demostrations Specific adaption/ modification of tools as required Use of jigs and fixtures	Magnifying lenses Talking books (tapes) Oral interpretation of visual aids/media Hand-on-hand technique for explaining specific manipulative movement processes Use of jigs and fixtures Peer tutors Self-instructional materials Large print

TABLE VIII, continued

	Hearing Impaired	Learning Disabled	Mentally Retarded	Physically Handicapped	Visually Impaired
Equipment	Warning lights and flags, and machine status indicators, fans can be used as a warning Heat sensing indicators Vibrating devices Extensive use of signs/tags Written rules for each machine Checklists, posters, charts Ear protectors in high noise areas	Personalized individual demonstrations and evaluations Checklists for key procedures and machines Color coding of tools, safety zones, guards, etc. Check reading levels Symbol "word" signs and warnings	Personalized individual demonstrations and evaluations Checklists for key procedures and machines Check reading levels Symbol "word" signs and warnings	Adaption of equipment as needed, e.g.: Adjustable heights Repositionable controls Tool holders and holsters Velcro grippers Convex pushbuttons designed to operate with a minimum of pressure Safety control interlocks Hoists where needed Foot controls Heat sensitive switches Arm rests Large control levers Keep reach short by using control extensions, relocations, positioning of bins, trays and tools Special helmets Television and/or overhead mirrors for adequate rear vision of stove tops, workbenches, and demonstration areas Appropriate jigs and fixtures	Appropriate jigs and fixtures Warning buzzers, bells for power on/off switches Click gauges Optacon electronic sensory reader Magnifying lenses and equipment Prescription spectacles Machine adaptions may be necessary (e.g. digital readouts) Brailled directions, time pieces Warnings signs should be Brailled or tacticle as well as visual Varied shapes and surface textures for operating knobs Large print for directions Keep equipment stationary

TABLE VIII, continued

	Hearing Impaired	Learning Disabled	Mentally Retarded	Physically Handicapped	Visually Impaired
Fire equipment/ evacuation	Warning lights to supplement fire alarm Buddy systems	Warning lights to supplement fire alarm Posted evacuation routes Buddy systems Symbolic signs, pictorial directions	Rehearsed evacuation procedure Posted evacuation routes Buddy systems	Adequate fire exit widths, accessibility in conformance to standards Low location of emergency signals and fire alarm switches for ready accessibility Buddy systems Wall rails	Handrail guards Audio alarm system Buddy systems Wall rails
Materials	Mark pressurized container clearly	Clear labels for chemicals, paints, flammables Use standardized symbols for dangerous materials	Use standardized symbols for dangerous materials	Store at reachable heights	Braille or raised label markings for dangerous material, e.g. gasoline, ammonium-nitrate, acetylene, etc.

placement and strategy development discussions. Certainly the student's safety and health should be considered within this section of IEP development.

Suggested Teaching Techniques

Effective teaching obviously serves special needs students as well as others not so classified. However, the implementation of certain practices maximizes the safety of vocational special needs students. Certainly these practices are desirable not only for how they help special needs students operate safely, but also for how they help other students do so. A sample of these practices and precautions includes:

1. checking of medical records and student files to ascertain the possibilities of student loss of control, seizures, etc.
2. assignment of students to specific shop/laboratory areas.
3. on-going observation of student work skills.
4. evaluation using a variety of oral, written, and performance techniques.
5. using jigs and fixtures for work holding, safety, and positioning.
6. enhancing teacher-student communication by using devices that improve reception and/or sending of information.
7. individualization of instruction to meet specific special needs characteristics as suggested by appropriate consultants and by the IEP.
8. minimizing access problems and barriers.
9. using the school system's resource personnel (e.g., counselors, psychometrists, teacher aides, etc.) to support learning in vocational education.

SPECIAL NEEDS RESOURCES

1. Missouri LINC
   609 Maryland
   University of Missouri
   Columbia, Missouri 65211
   Toll Free Hotline # 800-392-0533 for answers to questions related to Vocational Education and Special Needs students

2. Vocational Instructional Materials for Special Needs Groups
   Human Resources Management, Inc.
   1101 30th Street, N.W. Suite 301
   Washington, D.C. 2007

3. The National Center for Research in Vocational Education
   1960 Kenny Road
   Ohio State University
   Columbus, Ohio 43210

4. Midwest Regional Resource Center
   Drake University
   Des Moines, Iowa 50311
   (515) 271-3936

5. Instructional Development for Special Needs Learners
   Department of Vocational and Technical Education
   University of Illinois at Urbana-Champaign
   Urbana, Illinois 61801

6. Vocational Education Inservice Training
   Department of Special Education
   University of Kansas Medical Center
   Children's Rehabilitation Unit/University Affiliated Facility
   Kansas City, Kansas 66103

7. Wisconsin Vocational Studies Center
   University of Wisconsin-Madison
   964 Educational Sciences Building
   Madison, Wisconsin 53706
   (608) 263-3696

8. The Career Education Center
   Florida State University
   Florida State Department of Education
   Division of Vocational Education
   Tallahassee, Florida 32306

9. LINC Resources, Inc.
   1875 Morse Road
   Suite 225
   Columbus, Ohio 43229

10. The President's Committee on Employment of the Handicapped
    Washington, D.C. 20210

Chapter 8 Useful Information Sources

REFERENCED MATERIALS

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- Retail Lumber and Building Materials, Pub. #75-146
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- Hotels and Motels, Pub. #76-112
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RESOURCE AGENCIES

The State of Missouri

Industrial and Technical Referral Center
1020 Engineering Building
University of Missouri
Columbia, MO 65211

Phone: 314-882-2987

Contact:_____

A program concerned in developing in-depth training seminars on work-place hazard topics for labor and management throughout Missouri and to provide reference literature, training materials and technical assistance to those who wish to conduct their own training programs.

Missouri Safety Council
312 East Capitol Avenue
Jefferson City, MO 65101

Phone: 314-636-8167

Contact:_____

Missouri chapter of the National Safety Council as a non-governmental, privately supported, public service organization. An all-purpose safety council with safety programs in traffic, occupational, rural, and youth. The Missouri Safety Council is involved in disseminating public information and education as well as specific training programs.

Missouri State Department of Elementary and Secondary Education
100 East Capitol Avenue
Jefferson City, MO 65101

Phone 314-751-4212

Contact:_____

The state agency responsible for elementary and secondary education. The department's Division of Career and Adult Education will be of primary interest to vocational educators. Contact its subject matter supervisors for specific information pertaining to your service area and for assistance.

Missouri State Department of Public Safety
Director's Office
621 East Capitol Avenue
Jefferson City, MO 65101

Phone 314-751-4905

Contact:_____

A department of the state with enforcement divisions and emergency divisions of:

Enforcement		Emergency
• State Highway Patrol	• Water Safety	Adjutant General (National Guard)
• Liquor Control	• State Fire Marshall	Disaster Planning and Operation

Bureau of Radiological Health
Missouri Division of Health
P.O. Box 570
Jefferson City, MO 65102

Phone: 314-751-2713

Contact:_____

Information concerning radiation or its effects.

UMC Guides
Publications Office
222 South 5th Street
University of Missouri
Columbia, MO 65211

Phone: 314-882-7216

Contact:_____

Useful and informative publications available to the public in areas of agriculture, home economics, home and garden, engineering and others. A publications list is available.

Poison Control Center
Mid-West Region
The Children's Hospital
Omaha, NE 68105

Phone: 1-800-228-9515
Note: If call is for informational purposes, state that fact after being connected to the Center.

Contact:_____

There are various centers located in cities across the state of Missouri that could assist in poison information or emergencies. Consult local phone directories and enter that phone number, if available, below:

Missouri Division of Health
Bureau of Emergency Medical Services
P. O. Box 570
Jefferson City, MO 65102

Phone: 314-751-2713
(State Coordinator)

MISSOURI POISON INFORMATION CENTERS
*American Association of Poison Control Centers Designated Regional Center

State Coordinator

Phone: 314-751-2713

St. Francis Medical Center
St. Francis Drive
Cape Girardeau, MO 63701

Phone: 314-651-6235

University of Missouri Medical Center
807 Stadium Road
Columbia, MO 65211

Phone: 314-882-8091

St. Elizabeth's Hospital
109 Virginia Street
Hannibal, MO 73401

Phone: 314-221-0414 ext. 183

MISSOURI POISON INFORMATION CENTERS, continued
*American Association of Poison Control Centers Designated Regional Center

Charles E. Still Osteopathic Hospital
1125 South Madison
Jefferson City, MO 65101
Phone: 314-635-7141 ext. 173

St. John's Medical Center
2727 McClelland Boulevard
Joplin, MO 64801
Phone: 417-781-2727 ext. 393

Children's Mercy Hospital
24th at Gillham Road
Kansas City, MO 64108
Phone: 816-234-3000

Kirksville Osteopathic Hospital
800 West Jefferson Street
Kirksville, MO 63501
Phone: 816-626-2266 or
816-626-2121

Lucy Lee Hospital
330 North Second Street
Poplar Bluff, MO 63901
Phone: 314-785-7721 ext. 264

Phelps County Memorial Hospital
1000 West 10th Street
Rolla, MO 65401
Phone: 314-364-3100

Methodist Medical Center
Seventh to Ninth on Faraon Street
St. Joseph, MO 64501
Phone: 816-271-7580
816-232-8481

Cardinal Glennon Memorial Hospital for Children
1465 South Grand Boulevard
St. Louis, MO 63104
Phone: 314-772-5200

St. Louis Children's Hospital
P. O. Box 14871
500 South Kingshighway
St. Louis, MO 63178
Phone: 314-454-6099

Lester E. Cox Medical Center
1423 North Jefferson Street
Springfield, MO 65802
Phone: 417-831-9746 (collect)

St. John's Hospital
1235 East Cherokee
Springfield, MO 65802
Phone: 417-885-2115

West Plains Memorial Hospital
1103 Alaska Avenue
West Plains, MO 65775
Phone: 417-256-9111

NATIONAL AGENCIES

American Association of
Vocational Instructional Materials (AAVIM)
120 Engineering Center
University of Georgia
Athens, GA 30602

Phone: 404-542-2586

Contact:_____

This association provides material related to the entire field of vocational education, and has a number of items that relate directly to the field of safety education. This material may also be obtained from:

Instructional Materials Laboratory
Room 10 Industrial Education Building
University of Missouri
Columbia, MO 65211

Phone: 314-882-2883

Contact:_____

American Industrial Hygiene Association
66 South Miller Road
Akron, OH 44313

Phone: 216-762-7294

Contact:_____

Purpose to disseminate knowledge of the field and to promote the study and control of environmental factors effecting the health of industrial workers.

American Insurance Association
Engineering and Safety Service
85 John Street
New York, NY 10038

Phone: 212-433-4400

Contact:_____

Advising organization serving a number of companies in the property-liability insurance field. Publishes recommended safety programs and procedures, codes and ordinances for buildings and the control of fire hazards.

American Medical Association
535 North Dearborn Street
Chicago, IL 60610

Phone: 312-751-6000

Contact:_____

Concerned with industrial nursing, workmen's compensation and rehabilitation, occupational dermatoses and industrial opthalmology. Published materials such as electrical safety, fire and explosion, hand safety, material handling and storage and the psychology of safety may be obtained.

American National Red Cross
17th and E Streets, N.W.
Washington, D.C. 20006

Phone: 202-737-8300

Contact:_____

First aid texts and courses, instructor's manuals, charts and other teacher materials can be provided. Visual aids, such as films and posters available through local chapters.

American National Standards Institute, Inc. (ANSI)
1430 Broadway
New York, NY

Phone 212-354-3300

Contact:_____

Coordinates and administers a standardization system in the United States for the protection of the consumer and industrial worker. Publishes standards for equipment and safety items.

American Society of Safety Engireers
850 Busse Highway
Park Ridge, IL 60068

Phone: 312-692-4121

Contact:_____

Professional society for safety specialists. Many local chapters have active assistance programs for schools.

American Technical Publishers, Inc.
12235 South Laramie Avenue
Alsip, IL 60658

Phone: 800-323-3471

Contact:_____

Materials available for many facets of vocational education, including the area of safety education.

American Vocational Association
2020 North 14th Street
Arlington, VA 22201

Phone: 703-522-6121

Contact:_____

Provides a comprehensive directory of classroom resources for all service areas of vocational education. The journal also publishes articles on various topics related to safety.

Illuminating Engineering Society
345 East 47th Street
New York, NY 10017

Phone: 212-644-7926

Contact:_____

Provides data on types and amount of illumination to be used in classrooms and the various vocational education laboratories.

Industrial Health Foundation, Inc.
5231 Centre Avenue
Pittsburgh, PA 15232

Phone: 412-687-2100

Contact:_____

The foundation is a non-profit research association of industries. Activities include industrial health programs, working conditions and improved human relations. Bulletins, pamphlets and a monthly digest provide information on the topic of industrial health.

Industrial Safety
Equipment Association, Inc.
2425 Wilson Boulevard
Arlington, VA 22201

Phone: 804-525-1695

Contact:_____

Represents manufacturers and distributors of industrial safety equipment. Promote public interest in safety and development of efficient and practical personal protective equipment.

Job Safety and Health Instruction Materials
Technical Education Research Center-Southwest
4800 Lakewood Drive
Waco, TX 76710

Phone: 817-772-8756

Contact:_____

A number of self-contained packages are available that relate to various areas of industrial safety.

National Commission on Safety Education
National Education Association
1201 16th Street, N.W.
Washington, D.C. 20036

Phone: 202-833-4000

Contact:_____

Magazines, bulletins, pamphlets, checklists, posters for all levels of education and all aspects of safety education.

National Fire Protection Association
470 Atlantic Avenue
Boston, MA 02210

Phone: 617-482-8755

Contact:_____

Clearinghouse for information on fire protection and fire prevention. Technical standards are widely accepted by state and municipal governments.

National Safety Council
444 North Michigan Avenue
Chicago, IL 60611
Contact: Head, School & College Department

Phone: 312-527-4800

Contact:_____

A large number of resources are obtainable from the NSC in various media forms that cover a wide range of areas and age groups.

National Society to Prevent Blindness
79 Madison Avenue
New York, NY 10016
Contact: Director of Eye Safety Programs

Phone: 212-684-3505

Contact:_____

A voluntary health agency to prevent blindness through community service, public and professional education, and research. Among the many activities of this agency, the promotion of vision testing, exhibits, statewide eye safety for all educational areas and the administration of the Wise Owl Club of America, incentive program to utilize eye safety protection.

National Institute of Occupational
Safety and Health (NIOSH)
Publications and Dissemination
4676 Columbia Parkway
Cincinnati, OH 45226

Phone: 513-684-8235

Contact:_____

NIOSH Regional Office
601 East 12th Street
Kansas City, MO 64106

Phone: 816-374-5332

Contact:_____

These are a number of resources that can be obtained from the regional office that pertains to safety in the practical arts and vocational-technical education classroom or laboratory. See Additional Resources section.

Occupational Safety and
Health Administration
United States Department of Labor
14th Street and Constitution Avenue, N.W.
Washington, D.C. 20216

Phone:

Contact:_____

Regional office
U.S. Department of Labor
Federal Building Room 3000
911 Walnut Street
Kansas City, MO 64106

Phone: 816-374-5861

Contact:_____

There are a number of resources that can be obtained from the regional office. Forms of record keeping and reporting accidents to the standards that regulate industry.

Underwriters Laboratory, Inc.
207 East Ohio Street
Chicago, IL 60611

Phone: 312-272-8800

Contact:_____

Not-for-profit organization to conduct laboratory examination and testing of devices, systems and materials to determine their safety.